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PARENTAL PLAY OF CHIMPANZEES

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[*Plates 8–9*]

THE FAMILY GROUP

During the summer of 1924 the writer had the unique privilege of observing social relations in a chimpanzee family.[1] The three individuals comprising this family group were housed in a commodious cage near Havana, Cuba. Jimmy, the father, probably twenty-five years old, was an irascible male who had been mated once before the present mating. Monona, a mother for the first time,[2] was probably not more than twelve years old. Lita, the female child, was born on January 22, 1923, and during the period of observation was between the known ages of seventeen and twenty months.[3]

This relatively simple unit of chimpanzee society was separately housed in a colony of infrahuman primates consisting of fourteen chimpanzees in addition to many monkeys, baboons, a gibbon, and three

[1] This opportunity was provided through the generosity of Madame Rosalie Abreu and the financial support of the Carnegie Institution of Washington. The private grounds and home of the former, known as the Quinta Palatino, were freely opened to a scientific group headed by Prof. Robert M. Yerkes. As a member of this group the writer enjoyed unlimited freedom for observing a remarkable collection of primates. For the hospitality of Madame Abreu, an honorarium from the Carnegie Institution, and the invitation of Professor Yerkes to join the party of observers, my heartiest thanks are due.

[2] On March 24, 1926, she gave birth to a second female baby, Cubita.

[3] Further description of the individual members of this family appears in *Almost Human* by Robert M. Yerkes, chapters 4 and 10. Supplementary facts bearing on the colony as a whole appear in chapter 3.

orang-utans. The majority of the chimpanzees were in a stage of development readily recognizable as childhood. Three chimpanzees, perhaps,—a male and two females—had reached early adolescence. Ranging from the end of infancy or early childhood to adult parenthood, therefore, this collection of animals furnished rare opportunities for comparing various aspects of social behavior in which the family group naturally occupied a central place.

From the first there were observed striking differences between the social activities of the family, on the one hand, and, on the other, those of the non-family groups. In all groups there were significant changes as acquaintance progressed between the chimpanzees and their human visitors. Among the adolescent and pre-adolescent chimpanzees a rough-and-tumble variety of play tended at first to dominate the observer's attention, but shortly there appeared less spectacular but more subtle and still more fascinating varieties of social behavior. Such changes in observations doubtless were due in part to the observer's increasing background, but the behavior of the animals was unmistakably different after they became accustomed to a foreign gallery.

In contrast with the romping playfulness of the young animals, Monona seemed to exercise ceaseless vigilance over her child. Never, it seemed, was Lita permitted to get out of the range of Monona's vision. If Lita went from one room to the other, she was consistently followed by Monona. Jimmy seemed never to take responsibility for the care of the child. On the other hand, he was never seen to interfere with the welfare of the child or mother although Monona took no chances when one of his expressons of temper was released. On such occasions she took the child on her back and climbed, whimpering, beyond the range of his violent behavior. Once or twice, Lita seemed to whimper also, but this uncertain observation was not satisfactorily confirmed. During none of these emotional outbursts, however, was he ever observed to threaten Monona or Lita.[4] Generally the family life was remarkably peaceful.

This family situation was one that readily challenged the observer to look for activities, especially in the mother, indicative of less seriousness than the primary business of protection. An unverified report came from the caretakers that Jimmy often, Monona never, played with the child. After many hours of daily observations at the family cage, at

[4] Fear that Jimmy might injure the child was expressed by attendants who regularly hurried to the cage when one of his uproars began and, from the outside, drove him with threats into an isolated compartment.

least a partial list of maternal play activities was obtained, but more than once Jimmy played with Lita before Monona was seen to play with her at all. In my presence he played less slyly than Monona. Also, he revealed less variety than she.

Efforts to photograph such activities were always unfruitful because the necessary equipment was consistently avoided by the parents. By Monona, also, the more trustful and playful Lita was quite successfully kept away from the cameras. Four reproductions on each of two accompanying plates represent fairly typical photographs of the mother in non-playful poses. Maternal relaxation was always discouraged by the presence of a camera, but Lita often responded playfully.[5]

The four pictures in plate 8 represent the mother and child caught unexpectedly. In figure 3 Lita, and in 4 Monona, only, is looking towards the camera. In figures 5 and 6 of plate 9, Lita has started towards the photographer. She usually came forward so rapidly that she was quickly out of focus and the photograph failed. Also, she frequently stamped with her feet, evidently in play threats, at the photographer. Figure 6 shows her in such an approach. In both 5 and 6, Monona is seen about to start after the heedless child, and in 7 and 8 she was photographed shortly after recovering Lita. She was walking rapidly in both cases. The fact that she walked through a spot of sunlight in the heavily shaded cage made the eighth photograph possible. In it her irritation is indicated by the upstanding hair on head and shoulders and, possibly, by the lips.

The failure to record photographically the play activities that took place was a disappointment and a misfortune. The gross behavior described in this paper was accompanied by less easily describable variations in facial expression which supplemented significantly the

[5] Disturbances in the family accompanying photographic preparations are concretely illustrated by a recorded observation on July 17: "Cameras were placed near the cage in an effort to get photographs of the family. Jimmy was thoroughly excited and repeated over and over his 'stallion-like' roaring and banging. It was at this time that a rare indication of maternal roughness towards the child was observed. My attention was first attracted when Lita seemed to be crying softly. When I looked, the mother was following Lita who seemed to be trying to run away. Monona, who easily caught Lita, pulled her back roughly, swung the child around to her side, and clearly offered opportunity for Lita to mount her back. Monona reached down and back and seemed to push or lift the child towards her back, but Lita did not get up. She compromised by putting up one hand, clinging to the hair at the mother's side, and walking alongside (see plate 9, fig. 8). Monona made low vocal sounds as she paced about the cage with Lita."

recorded facts. Without photographic records for sustained inspection, however, such details can not be reported with certainty. In such omissions the reader is deprived of essential facts that exerted considerable influence on the observer. Perseverance in the development of appropriate facilities for photographic records of activities that are uninfluenced by human observers will, no doubt, ultimately eliminate the necessity of such omissions.

The evidences of parental play are supplemented in the following account with certain observations reported to the Institute of Psychology by Mrs. Helen M. Ireland who made occasional visits to the Quinta Palatino following the birth of Cubita, Monona's second baby. These recent records by Mrs. Ireland confirm or supplement certain portions of the play between Monona and Lita previously recorded and now reported by the writer. The combination of facts has particular significance because Lita had reached the beginning of childhood whereas Cubita was observed during the early weeks of infancy.[6]

THE FAMILY ENVIRONMENT

This family of chimpanzees was housed in an outdoor cage nearly sixty feet long and thirty feet wide. The corners were rounded giving it the appearance of an ellipse with flattened sides. From one side three doors led to as many separate dens or sleeping compartments. The entire structure, including various artistic features, was deeply shaded by the foliage of large trees. A water-tight roof covered approximately the middle forty feet of the cage.

The cage was divided by a partition of vertical bars into two rooms, designated A and B. A small doorway connected the two rooms. The partition, like most parts of the enclosure bars, was covered with wire mesh to prevent the confined animals from reaching through. Across the upper part of the cage horizontal beams of iron or steel were joined to opposite sides. The cage was further braced by oblique bars joined above to the horizontal cross beams and two-thirds of the way down to the vertical bars. These braces were commonly used by the animals for climbing to the attic where several shelves had been arranged. The

[6] The observations of Mrs. Ireland cover a period of infancy parallel to observations reported on a different chimpanzee mother by G. J. von Allesch (see p. 88). A comparison of Mrs. Ireland's notes and von Allesch's report leaves the writer with the impression that Cubita was more precocious and better cared for by the mother than the infant observed by von Allesch. One wonders, if such be the case, whether Monona's earlier experience in rearing Lita is a significant factor.

lower ends of the vertical bars were embedded in a substantial curbing of concrete. The entire floor was made of concrete.

Room B included approximately one-third of the entire cage. It contained a round table with two chairs at opposite sides of the table. These immovable furnishings were made of reinforced concrete. In this room all of the recorded play by Monona and Lita was observed. Occasionally Jimmy was confined in the adjoining compartment, A, but for the most part the family had free access to any part of the cage.

In room A the play of Monona with Cubita, as recorded in and selected from the general notes of Mrs. Ireland, took place. This room contained a concrete arch and a sunken (dry) watering tank. Throughout Mrs. Ireland's observations during Cubita's infancy, Jimmy was confined alone in B.

On account of the size of the family cage and the importance of the observer remaining inconspicuous, there were difficulties in following the activities of the family group without interruption. On several occasions play activities were witnessed but they could not be adequately described. The most favorable opportunity for such observations and descriptions came when the animals were confined in a single room.

PATERNAL PLAY

Jimmy's playfulness was conspicuously limited when compared with that of younger chimpanzees. Romping, tumbling, swinging, and other forms of vigorous play were rarely, if ever, exhibited by him. On the other hand, he responded with evident playfulness in various situations whereas Monona's playfulness seemed even more restricted and limited to Lita. To the foreman of the Quinta Palatino, and even to the visiting observers, Jimmy frequently responded playfully. Such responses probably were no less frequent than his outbursts of temper.

The following summary of Jimmy's play with the foreman (L) was observed with variations several times: Outside Jimmy's cage, L slaps wire mesh; Jimmy from inside responds similarly and opens his mouth in good humor. L puts a finger through the wire mesh, the end turned upwards; Jimmy hooks the end of his finger over L's and pulls. Repeated many times. L bends fingers in chimpanzee fashion and strikes wire mesh; Jimmy responds similarly at same place. L takes Jimmy's fingers through wire mesh and trims finger nails; Jimmy sits patiently and watches the procedure.

Some three weeks after observations began, my notes contain a reference to Jimmy's initial playful response to Professor Yerkes and me: As

usual we stopped this morning (July 25) before the family cage on arrival at the Quinta Palatino. Jimmy lay on the table in room B. As we paused, Professor Yerkes said, "Hello Jim." Slowly Jimmy got down from the table, rose to erect position, and suddenly ran at us, spatting his feet on the floor, and slapped the cage before our faces. It was a startling change from the lazy appearing animal that got off the table.

This manifestation of playfulness was unusual. During the first two weeks of our visit, Jimmy quite consistently gave vent each morning to violent yelling and furious rushes about the cage when we arrived at the Quinta Palatino.

Jimmy's play with Lita was first noted on July 7. It was my fourth day of observation at the Quinta Palatino and several days before any of the animals showed familiarity with me. The entire afternoon was used in watching the family activities. The following activities took place within a half-hour period.

Jimmy, Monona, and Lita had been lying in A near the sunken watering tank. The parents were eating mangoes and Lita was playing on the floor some eight or ten feet distant. Jimmy got up and lazily approached Lita, stood on all fours with his head extended forward and downward towards her, and looked at her for a minute or more as she continued her kittenlike play. Occasionally he rolled his eyes, without turning his head, toward me. (I was compelled to move somewhat in order to get a clear view of the animals and he was evidently watching me.)

Monona now got up, walked past Jimmy and Lita, and was closely followed into B by Lita. Presently Lita climbed one of the brace rods to a cross beam. From the side of the cage she walked out some twelve or fifteen feet. Jimmy, who had also gone to B, climbed to the cross beam as Lita had done. Instead of getting *on* the steel beam like Lita, he grasped it from below with hands and feet, walked out, upside down, to a position directly under her.

Lita now turned around on the cross beam and walked back to the side of the cage. As she returned, Jimmy backed up keeping himself directly below her. When they reached the side of the cage, Lita climbed down, but Jimmy continued to hold himself suspended from the cross bar. He rotated his head as though to watch her and when she reached the floor he extended a hand which she grasped with both of her own hands. Then he swung her back and forth, perhaps a half dozen times, covering an arc of six feet or more.

Later, in another part of the cage, the family had again assembled.

Jimmy, sitting on his haunches, reached over and pinched Lita. His behavior was very similar to Monona's as described under *grasping and tumbling* (p. 85).[7]

[7]This literal account, when read in manuscript, arouses pictures of a chimpanzee family so different from those which came with first hand contacts, that I am compelled to recognize its failure to convey a true spirit of the situation. The chief reason, I believe, lies in the elimination from the manuscript of spontaneous interpretations which appear without inhibitions in the daily notes. The inadequacy of the objective report is so apparent in review that I am led to supplement it with this appended note in an effort to correct the loss of that spontaneity which actually existed at the time of the observations. The necessity of objective reports is fully recognized, but it seems unscientific to close one's eyes to the probable injustice, especially when dealing with man-like animals, that our scientific shyings at anthropomorphism have introduced.

The letter quoted below is highly anthropomorphic. It has the merit, I believe, of describing a particular aspect of the family situation in the chimpanzee cage, intelligibly and honestly. I should be better satisfied if the paper as a whole represented a fair compromise between the two extremes. The letter, as the context indicates, was written for an audience of children but, in spite of the personal nature, it is quoted in part, and without editing, as an illustration of my observations when reported without subjective restraints:

"Reina 48, Piso 2°,
Havana, July 10, 1924.

My dear Robert:

You have probably heard the letter I wrote to Bernice about the Chimpanzee family. If not, perhaps you can get mother to read it to you. I told Bernice about the father and mother Chimpanzee and their baby. Baby Chimpanzee's birthday is the same day as mine and it was just one year old last January 21st. [January 22 was later found to be the correct date.]

Mother Chimpanzee and Baby seldom play together. I guess it's about the same as with your mother. She is too busy looking after you and George to play. This mother thinks she hasn't time for play, but the father Chimpanzee plays with his baby a lot. But yesterday, I saw the mother play, in her way, with her baby. The mother Chimpanzee plays differently with the baby than the father Chimpanzee.

The mother was lying on her back and her short legs stuck up in the air. She held baby Chimpanzee in her big hands, and baby's face lay against the mother's cheek. Then they rubbed noses and cheeks, and I suppose they gave each other some butterfly kisses. I saw them kissing with their lips several times, but they did not smack. They just put their lips together. Occasionally, too, the mother Chimpanzee would nip baby's ear. They played for several minutes as I have seen you and your mother play, especially before you could walk.

After a while baby Chimpanzee climbed on the mother's back and rode around the cage. Then the baby got down and climbed up the side of the cage. Baby played there for some time, then jumped down, and landed pretty hard. Her

MATERNAL PLAY

On July 12, 1924, Monona and Lita were confined in room B. Jimmy was in A. During three hours of continuous observation practically all forms of play that appeared throughout the summer were manifested by Monona. More complete and unified records of maternal play, with fewer ambiguities, were obtained at this time than at any other observation period. With this one exception Monona was never seen to exhibit more than one or two forms of play during a single period of observation. Most of the quoted notes are selected from the records of that day.

Aside from the separation from Jimmy this situation on July 12 contained another unusual feature. The heat was highly oppressive and all of the animals, human attendants included, were significantly quiet. Lita played somewhat kittenlike on the floor of the cage and Monona changed restlessly from place to place. After lying down she would change her position repeatedly before moving to another place. Lita usually followed the mother during such changes of location. Occasionally Monona followed Lita.

Submissiveness. This topic is introductory to several aspects of the mother's play. It signifies in a general way a relaxation of parental sternness. Monona's toleration of Lita's activities, at times, could be sharply distinguished from her restraints, at others. Opposition to Lita's play was seldom noted when the activities centered about the mother, but if Lita played elsewhere, for example, through the bars with human spectators, Monona often interfered by taking her away.

An example of Monona's submissiveness appeared on July 12. A few minutes earlier she had been playing mildly with Lita in a manner similar to that described below under *hand and foot claspina*. When this play ceased, Monona lay down on the floor. Lita continued by picking at Monona's feet and toes without eliciting responses other than spreading and closing of toes. Lita's manipulations now changed

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little feet slapped quite loudly on the cement floor and she whined just a little and held out her hands to her mother who got up and went near so baby could get on her back again.

Pretty soon Father Chimpanzee came around and Mother Chimpanzee, carrying Baby, began to walk slowly around the cage. Father Chimpanzee fell in directly behind and thus they paraded about for a long time. It makes me think of you and George when you march, only the Chimpanzee family made no noise. They stepped softly, and more slowly than you and George, and the 'band' was not played. Their parade was slow and very quiet."

from the mother's feet to anus which she inspected visually and tactually. Then she spread the external genitalia, peered within, and inserted her lips at least three times. She seemed to treat this part of the mother's anatomy as something merely to manipulate and explore. The mother permitted all of this picking and pulling without noticeable protest or unusual response. Significant was Monona's apparent indifference to Lita's activities. Her line of visual regard was quite away from the child's location.

There were other occasions when the mother seemed to watch closely the antics of the little one but with no exercise of restraint. Such behavior seemed to be intermediate between the lazy toleration of the child's playfulness on the one hand, and active participation in the play on the other. At such times, the mother usually sat on her haunches and rotated her head in relation to Lita's changes in location. This visual pursuit sometimes immediately preceded and regularly accompanied some of the maternal play activities which follow.

Hand and foot clasping. The manual activities of Lita, in this rôle, represent a variation of the 'picking' at Monona's feet and toes described above. Monona was stretched out on the floor near the table with her feet against one of the chairs. Lita climbed upon the back of the chair from which she reached down and pulled playfully at the mother's toes. The mother raised her foot, moved it about above her body, and spread and closed the toes as though seeking contact with Lita's hand. When such contact was established both closed momentarily in a clasp, pulled lightly against each other until the hold was relinquished, and promptly renewed the clasp in similar manner. Not less than a half dozen such contacts were made. Lita, from her position above, followed rather closely with her hand the devious course of Monona's foot. At times it appeared that Monona's foot movements avoided Lita's hand clasp. This particular aspect of the play probably lasted between one and two minutes.

Grasping and tumbling. This form of play was commonly preceded by the visual regard described above under *submissiveness.* Monona was sitting on her haunches and Lita was walking about near at hand.

As Lita came within Monana's reach, the mother extended a hand, grasped her about the body and legs, and pulled lightly but with sufficient force to cause Lita to sprawl, slide, and roll towards Monona. The mother did not follow up the act beyond continuing to look at the scrambling Lita regain her feet. Shortly, when Lita again came near, Monona caught Lita's hand in her own, gave it a light pull, but released the grasp almost as soon as Lita resisted.

Hugging and fondling. On another occasion the foregoing tumbling and grasping behavior was carried further. Monona lay down on her side and extended an arm as though inviting Lita to come. Lita went and lay close against the mother's breast while Monona encircled her with the arm that had been extended. Lita did not nurse.[8] She cuddled up momentarily, then climbed out of the mother's arms, over her body, and to the floor at her back. On another day there was noted similar behavior when the mother held the child in her two hands and brought their faces close together. In this act there was detected no sign of cleaning or licking.[9]

Tickling. This variety of maternal play is closely related to the foregoing. The following account is taken from my notes of July 12. Once again Lita was pulled by the mother and rolled on her back. The mother placed her fingers lightly in various places on Lita's upturned body. Lita was obviously 'tickled' by the procedure. She squirmed, rolled, and drew her feet and hands close together over the upturned ventral surface. She grasped the mother's hand with all fours. Monona withdrew her hand from Lita's grasp and returned it several times to Lita's body. The foregoing note was supplemented when written by the following comment: "No unprejudiced observer, I am sure, could have watched this behavior without defining it as 'tickling.'"

The interpretation of this behavior was confirmed in two wholly independent observations reported by Mrs. Ireland under date of June 11, 1926. Monona was holding her second infant, Cubita, who had reached the eightieth day. Having retired to a step leading to one of the dens, Monona "holds babe in arms, opens mouth, runs mouth and lips over babe's head, and tickles babe's chest." This record strongly suggests chance tickling through cleaning of offspring, but the following seems more certainly detached from the cleaning act: "Monona, chewing remnants of fruit, idly passes hand over babe's fingers and toes, and rests for a moment with tickling motions under babe's chin."

Rocking and carrying. Other adaptations of hugging and fondling due, perhaps, to age differences in the offspring were recorded by Mrs. Ireland on various days in April, 1926. "Monona at intervals raised

[8] Throughout the summer, Lita was seen only once to take the nipple in her lips and then only for a moment. Yet, on several occasions, Lita was held significantly in the arms of the mother. The two were never observed after they went to bed.

[9] Maternal cleaning of chimpanzee infants with lips and tongue is probably common. Lita had evidently outgrown such care by the mother.

Cubita (tenth day) towards her breast by placing a hand under the babe's buttocks. Presently Monona let the babe's head lay back in her cupped arm. With the babe's head thus pillowed, Monona gently moved her arm back and forth while she bent her head closely above the small figure she thus rocked." Cubita, twenty-first day: "Monona went to edge of cage and sat with feet squarely planted towards curb of cage; held babe's head in cupped hands, jogged it up and down, bent face close to nursling, and made faint kissing sound."

An elaboration of the foregoing behavior was also observed by Mrs. Ireland on Cubita's thirty-seventh day: "Monona, stretched at length on shelf, cuddles babe up and down against her breast. Babe makes continuous clucking sounds suggestive of content. Babe is turned on back and Monona's forefinger plays back and forth under babe's chin; its pink hands and feet wave gently. . . . . Holding babe in arms she rocks it to and fro in attitude of intense maternal devotion.

"Observer's eyes were momentarily turned away and as she looked back Monona was walking slowly across the floor, gently placing each extremity with careful precision. *The babe was riding on Monona's head*, bunched up, and clinging with hands and feet.[10] Monona raised hand at every step to feel child. The head carrying lasted three minutes."

April 30, 1926, Cubita's thirty-eighth day: "Mother lying on back, holds babe by upper arms and raises it so high that babe's heels rest in mother's eye sockets. Monona blinks but continues to sway child up and down."

[10] In a paper scheduled for later publication on sexual behavior of chimpanzees, there will be described a striking similarity in placement and carriage of pieces of mango by a female, Sita, who was nearing sexual maturity. With Malapulga, a sexually mature female, Sita was caged close enough to the family cage to permit the occupants of either cage limited visibility of each other. For direct comparison with Monona's head carrying of Cubita, selections from my notes of July 11, 1924, are quoted in this connection.

"Sita and Malapulga had been eating mangoes. Sita took a partially split mango from which the seed had been removed and spread the two halves over her head. She shifted it to various places on and above her shoulders before the joined halves were insecurely lodged over a shoulder. Then she began to walk gingerly about the cage. Her shoulders were conspicuously elevated; her neck seemed bowed and rigid. When she started to climb the fruit fell off. She picked it up and carefully arranged it on the back of her head with a half on either side. In this position it remained two or three minutes while she went slowly about on all fours. . . . . Repeatedly she was observed to hold a hand as though to catch it should it fall and then to touch it with a hand as though to replace or readjust the fruit."

G. J. von Allesch[11] reports an interesting genesis of the rocking behavior in Loca (previously named Rana by Köhler): "From the first day on (following the birth of her male baby) she trembled greatly due obviously to her general exhaustion. This trembling was distributed over the whole body or limited to certain parts, especially the arms or thighs. In the second week it was observed that this trembling of the thighs looked more and more like a dandling movement (Schaukelbewegung) and in the activity one could see a little later that the body of the young one was set in motion by the old one especially by patting the back with her hands. Gradually this motion became better defined and developed into a frequently used method of quieting, use of which was not made, however, when perchance the young one responded likewise or made a sound of distress, but at such times as the old one herself became excited or anticipated a danger which was commonly accompanied by a cry of distress from the young one. Whether this shaking had an independent origin or was only an adaptation of the reflex trembling could not be determined through the observations."

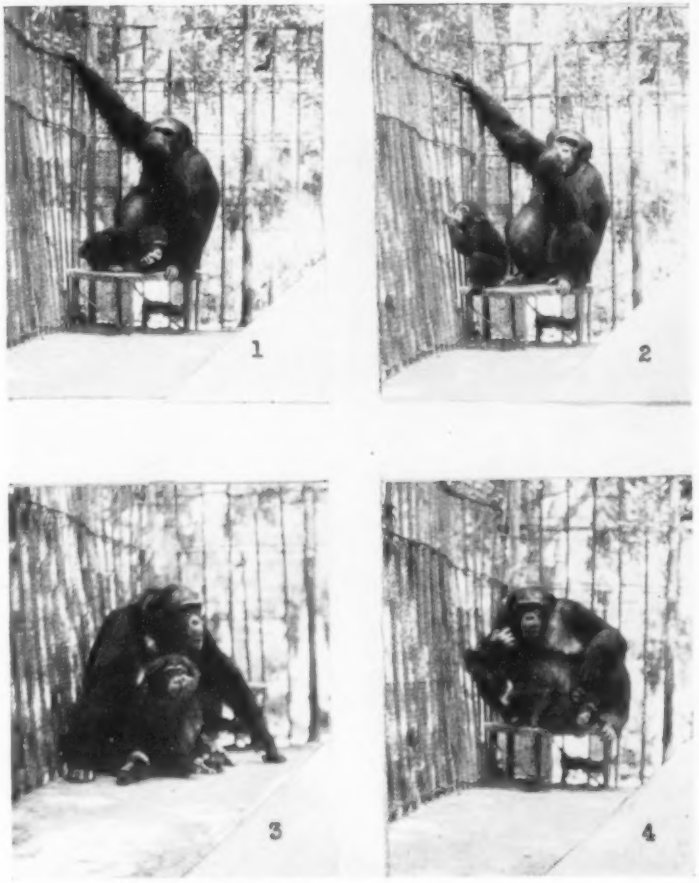
'Über Stock und Stein.' Another variety of maternal play has been reported by von Allesch[12] as observed in Loca when her baby was two and one-half months old. At this age the little male was making feeble excursions over the body of the mother, being unable to stand with any security on his bow-legs. His laborious journeys were made under the protection of a mother's hand and his own cautious clinging to the mother. "At this time Loca invented a special play. She lay on her back and held with her foot a little leg of the young one, let him crawl over her body, and then quickly drew him back again 'over hill and dale.'" It seems probable that Loca's behavior was essentially similar to that of Monona as described above under *hand and foot clasping* and *grasping and tumbling*. The main difference, it may well be, is to be found in the adaptations of the mothers to the different ages of their offspring.

Maternal tuition. A brief account by von Allesch[13] pertaining to locomotion at the end of the third month and beginning of the fourth month seems to deserve a place in this list of activities. Loca stood over him, held him by a hand, and compelled him, as she went backwards, to follow her on three legs; or she took him near herself and slowly led him floundering, going forward. At first this was rare and irregular

[11] *Bericht über die drei ersten Lebensmonate eines Schimpansen*, Sitz. d. Pr. Akad., 1921, p. 684; also, Die Naturwis., 1921, *9*, 774–776.

[12] Sitz. d. Pr. Akad., 1921, 685.

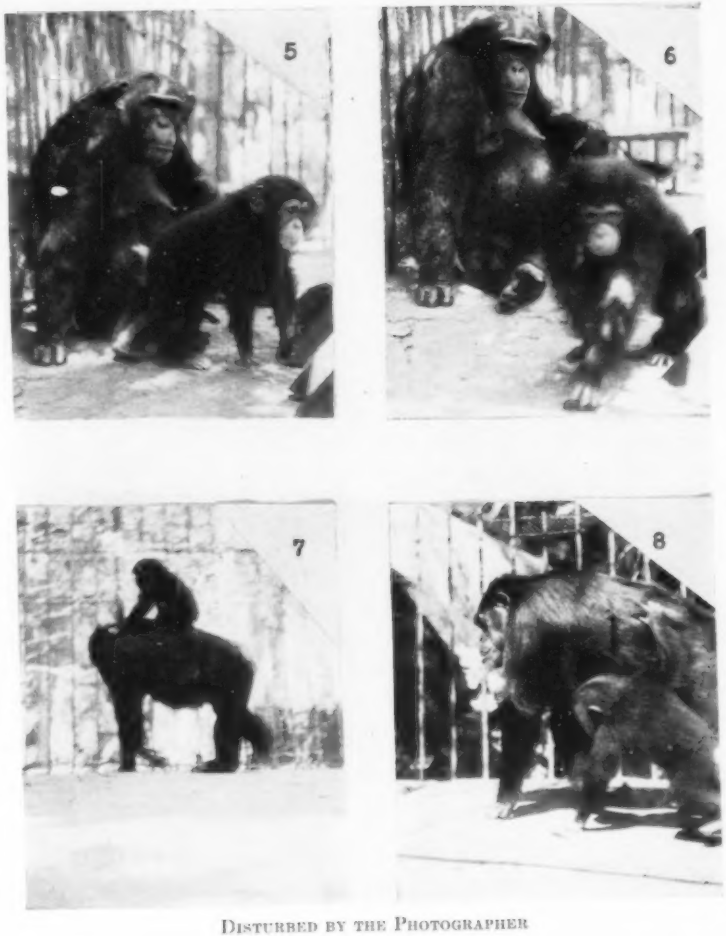
[13] Sitz. d. Pr. Akad., 1921, 685; also, Die Naturwis., 1921, 775.



MONONA AND LITA

Rarely was it possible to point a camera towards them without evidence of concern in the mother. Regularly she moved away with the child. It was exceptional, as in 3, to get an opportunity for a photograph when the eyes of the mother were not on the photographer. Lita, on the contrary, usually approached the photographer.

With the consent of the writer, 1 and 4 were previously published in Almost Human by Robert M. Yerkes; their use in this connection is through the courtesy of the Century Company.



DISTURBED BY THE PHOTOGRAPHER

In 5 and 6, Lita was leaving the mother to approach the presented camera. Monona is seen preparing to follow the child. In 7 and 8 the mother is seen after recovering the child. In 8, Lita resisted taking a place on the mother's back; she compromised by going but without mounting the mother's back.

With the consent of the writer, 7 and 8 were previously published in Almost Human by Robert M. Yerkes; their use in this connection is through the courtesy of the Century Company.

UNIV. OF MICH.

but by the end of the fourth month it was more significant and lasted over periods of ten minutes. Hindrances like stones and holes made no difference. Only when he tumbled and cried was he lifted up. In the beginning of the fifth month he was made to wade through a puddle of rain water. This was recognized as a special performance. At the same time the mother, scrambling up a high bank, tried for the first time not to carry but to lead him by the hand.

Chasing and evasion. This form of play obviously does not occur until the youngster's locomotor powers are fairly well developed. The following is taken from my notes when Lita was near the end of the seventeenth month: "Monona and Lita moved to the side of the cage near my observation post. Lita took a pebble from me when she climbed on the side of the cage and looked out. Monona took Lita by the foot and pulled her down. Then she walked, followed by Lita, to the other side of the cage. As they proceeded Lita grabbed playfully at the mother's feet and, seemingly in response, Monona increased her rate. They went thus around the cage (room B). Then Monona walked around the table and chairs, but in the meantime Lita had gone between the table and a chair to cut in ahead of Monona. Monona reversed her direction and Lita followed. The rate was now such that Lita had to run to keep pace. Three times the cutting in and reversal of direction took place. Monona did not run at any time, but she varied her strides and pace conspicuously.[14]

"Following this unusual locomotor activity, Monona sat down on her haunches. Lita went up to her and was hugged close to Monona with both arms. The embrace had the appearance of an affectionate hug terminating a mild romp."

Boxing. This activity was never manifested by Monona, but Lita frequently swung her arms in a manner resembling boxing. The suggestion that the mother might have previously participated in such play occurred on a single occasion. Lita ran up before her mother and, standing erect, swung both arms before Monona's face in crude boxing gestures. To the little one's arm swinging Monona made no manual response and she appeared surprisingly indifferent to it. Lita's manner of approach, in this instance, as well as the frequency with which such play has been observed among other young chimpanzees, is responsible for the suggestion that the mother might play a rôle in the development of such activities in her offspring.

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[14] Lita was seen to grab at the mother's feet on several occasions but this was the only time when Monona was seen to respond with evidences of play.

THE TRANSFER OF GAME AND FUR-BEARING MAMMALS FROM STATE TO STATE, WITH SPECIAL REFERENCE TO THE COTTONTAIL RABBIT

By L. R. Dice

On account of the depletion of native stocks of game and fur-bearing mammals in many states it is becoming the practice of sportsmen, game commissioners, and fur farmers to introduce fresh stock of some species from other states. The transfer of breeding stocks of wild animals from place to place is not by any means a new thing, but of late years more extensive introductions than ever before are being made.

If each kind of game or fur-bearing mammal occurred in North America only as a single race, without subspecies, there might be little danger in introducing stock from other states. If in North America there were only one kind of deer, for instance, there would probably be no serious objection to restocking Ohio with deer brought from Vermont, North Carolina, Colorado or Oregon. As a matter of fact, however, there are in North America a number of species of deer, and some of the species are made up of a number of subspecies or geographic races. Thus, deer for stocking secured from Oregon would represent a species different from the eastern white-tail, while those secured from Vermont, Colorado, and North Carolina would each be of a different subspecies. Nearly every other kind of North American mammal, likewise, is made up of a number of geographic races or, as they are called, subspecies.

It is this tendency of North American mammals to break up into a multitude of species and subspecies which complicates the transfer of game or fur-bearing mammals from state to state. The different subspecies of a species are sometimes closely similar to one another, differing only in minor characters of color or size; but often they are quite different in respect to color, size, habits, or disposition, and often in respect to all of these factors. These differences between geographic races of the same species have not been sufficiently appreciated, although hunters of wide experience are fully aware that such differences occur.

The species of game mammals which are now being introduced from state to state include the American elk, deer, snowshoe hare, cottontail rabbit, and probably others. It is known also that gray squirrels and fox squirrels have been stocked in some parks and preserves. The red fox and the muskrat and perhaps some other fur-bearing species have been transferred from state to state for breeding purposes. These last forms are usually kept in a state of semi-domestication, but undoubtedly

some individuals occasionally escape from captivity. The European hare has become established in several localities after being introduced for sporting purposes. However, I shall not consider particularly the introduction of species not native to North America.

In order to illustrate the extent to which one kind of game mammal is being transferred from state to state I give here a digest of the records I have been able to obtain of the introduction of the cottontail rabbit into the eastern states. For these records I am indebted to the game departments of the states listed and to several sportsmen's organizations. Unfortunately, the records are far from complete and most states keep no records of introductions. Cottontail rabbits, therefore, have likely been introduced into other states than those for which they are reported. Also the source of origin of the stock imported is usually not certainly known, so it is impossible in many cases to be certain as to the race imported.

RECORDS OF INTRODUCTION OF THE COTTONTAIL RABBIT

Connecticut. Meriden Sportsmen's Association in 1925 liberated about 150 to 200 cottontails probably from both Kansas and Minnesota; in 1926, up to March 2, it liberated about 50 from the same sources. The same organization several years earlier had liberated some cottontails from West Virginia.

Georgia. No record of introduction.

Illinois. No record.

Indiana. No record.

Kentucky. No record.

Maryland. In 1924 and 1925 the State Conservation Department liberated approximately 20,000 cottontails from the west.

Massachusetts. From a dealer in Kansas 240 rabbits were secured in 1924, and 408 in 1925.

Michigan. No record.

New Hampshire. No record.

New Jersey. State Board of Fish and Game Commissioners introduced, in 1916–1917, 4,435 rabbits purchased from a dealer at Elida, New Mexico. The following numbers of western cottontail rabbits, mostly from Missouri, were liberated in later years: winter of 1922–1923, 1,619 rabbits; 1923–1924, 8,874 rabbits; 1924–1925, 9,265 rabbits. These rabbits were released in all parts of the state.

New York. The State Conservation Commission has no records, although it informs me that some of the state game clubs have from time to time imported rabbits for stocking.

North Carolina. No record.

Ohio. No record of past introduction, but Kansas cottontail rabbits will possibly be introduced this year (1926) by the State Division of Fish and Game.

Ontario. No record.

Pennsylvania. The state Board of Game Commissioners each year purchases

large numbers of cottontail rabbits from Kansas and Missouri. They are liberated either on state game refuges or on private lands open to public hunting. In the season of 1924–1925, 58,404 rabbits were so introduced.

Rhode Island. No records of introduction, but efforts are now being made by the Commissioners of Birds to secure stock from Kansas and Oklahoma.

Tennessee. No record.

Vermont. No record.

Virginia. No record.

West Virginia. At least one sportsmen's organization has introduced a number of cottontails, but no details are at hand.

These records show that cottontail rabbits have been extensively introduced into Maryland, New Jersey, and Pennsylvania. Smaller numbers are known to have been introduced into Connecticut, Massachusetts, New York, and West Virginia. The states of Ohio and Rhode Island are also planning to introduce them.

It is evident that extensive naturalization of the cottontail has taken place in the east, and that the artificial introduction of this animal is on the increase. Such extensive introductions are certain to affect strongly the native cottontails of the northeastern United States.

As is well known to mammalogists, two species of native cottontails occur in the east. The New England cottontail (*Sylvilagus transitionalis*) occupies the southern parts of New England, southeastern New York, central Pennsylvania, and follows the Appalachian Mountains south to Georgia. The second species, *Sylvilagus floridanus*, occupies most all the eastern states south of Canada, excepting northern New England and the area occupied by the New England cottontail. While *Sylvilagus transitionalis* apparently does not break up into geographic races in different parts of its range, *floridanus* has a number of geographic races, some of which extend west to the arid plains and others occur in Mexico.

Two native races of *Sylvilagus floridanus* are found in the northeastern states. Their distribution is as follows: The eastern cottontail (*Sylvilagus floridanus mallurus*) occupies the Atlantic Coast States east of the Allegheny Mountains, extending north to lower New York state. The Mearns cottontail (*Sylvilagus floridanus mearnsii*) occupies the northern Mississippi Valley, extending east to the Allegheny Mountains, north to western New York, Ontario, and Minnesota; west to Iowa and Kansas; and south to northern Missouri and Kentucky.

Over the southwestern states the common cottontail is of a different species, *Sylvilagus audubonii*, also represented by many subspecies. It is certain that many of the cottontails sent to eastern states from Kansas and New Mexico, and perhaps Oklahoma, are of this species.

With the possible exceptions of the West Virginia cottontails liberated in Connecticut, all of the introductions of cottontails above listed probably represent the bringing in of a foreign kind of rabbit, with possible resultant hybridization with the native stock. However, in parts of New York state cottontails did not natively occur, and possibly some of those introduced into western New York and Pennsylvania may have been of the same subspecies (*mearnsii*) as the native form, though probably of somewhat different strain.

No certain information is available as to the ability of these different forms of the cottontail to hybridize, but it is unlikely that any race of the western *Sylvilagus audubonii* will cross successfully with the eastern *S. floridanus* group. In some preliminary experiments of my own I failed to get a captive male *S. f. mearnsii* from Michigan to mate with a female *S. a. baileyi* from Colorado, and they remained constantly antagonistic. Further, large museum series of specimens of rabbits from places where the ranges of two species overlap show no case of certain interbreeding.

It is presumed that interbreeding is possible between all the several races composing the *Sylvilagus floridanus* group of eastern cottontails; but interbreeding presumably does not occur between any member of this group and the New England cottontail, *Sylvilagus transitionalis*.

The Maryland Conservation Department and the Game Commissioners of Pennsylvania both state that they have received information that the introduced rabbits from the west have crossed with the native breed in these states. This presumably should occur, if the introduced form from the west is *Sylvilagus floridanus mearnsii*, and if the localities concerned are in the eastern part of Pennsylvania, where the subspecies *Sylvilagus floridanus mallurus* is the native form. Interbreeding should presumably also occur in western Pennsylvania on the introduction of *S. f. mearnsii*, as the native form in western Pennsylvania is of the same subspecies. However, we need more exact information as to what the parent stocks are, and what characters the hybrid offspring show.

Much has been said about the vigor of hybrid stocks. Among some groups of animals hybridization does seem to result in an increased vigor or reproduction and rate of individual growth, but it is not so certain that this vigor persists through many generations. In other cases hybrid stocks seem distinctly undesirable. It is hard to predict what the result of widespread hybridization of game animals will be, especially where the parent races are so distinct as are some subspecies. There is, it seems to me, a real danger that from the interbreeding of subspecies a race of

mongrels may often result, inferior in some or many characters to either parent. However, if the parent subspecies are not very different, as is true of the subspecies of *Sylvilagus floridanus* (*mearnsii* or *mallurus*) found in the eastern states, this danger may be slight.

Gamekeepers are inclined to be alarmed about the danger of wild stock degenerating through close inbreeding. The introduction of outside stock might be assumed to counteract this danger. However, there is no good evidence that the inbreeding of wild stock in nature has ever caused the least degeneration. Moreover, the recent careful experiments of Sewell Wright and others prove that in healthy stocks close inbreeding, even for many generations, results in absolutely no deterioration. The experience of stock breeders supports this conclusion, for nearly all our better lines of domestic animals are very closely inbred, and have been so for numerous generations.

Some of the state game commissions seem to have the belief that the rabbits being introduced from the west are superior in size and perhaps other qualities to the native forms. I fail to find any evidence to substantiate this belief. It is true that the New England cottontail (*Sylvilagus transitionalis*) is smaller, very slightly, than either the eastern cottontail (*S. floridanus mallurus*), or the Mearns cottontail (*S. f. mearnsii*). Both these latter forms are practically alike in size. So there would not seem to be any especial advantage in point of size of introducing the Mearns cottontail from the Mississippi Valley into any eastern state. Nor are there any other advantages from the standpoint of sport, so far as known, of the Mearns cottontail over either of the eastern forms. Furthermore, the cottontails of the *Sylvilagus audubonii* group, some of which are known to have been introduced into the east, are distinctly smaller and less valuable as a food animal than any native eastern rabbit.

Should rabbits of the *Sylvilagus audubonii* group of the west ever become well established in the eastern states they might eventually displace the much more valuable native forms. They are very vigorous, and from the observations which I have been able to make on captives they are far more pugnacious than the Mearns cottontail, and would possibly, if given a chance in a habitat to which they are suited, completely drive out the native eastern species. Fortunately they prefer the open plains and it is possible that they will not easily become naturalized in forests of the east, in spite of the exceptionally good opportunities which they are being given.

As has been previously stated, most kinds of mammals are represented

in North America by several geographic races, like those of the cottontail rabbit, and the transfer of any game species from place to place is open to a similar objection, owing to the possible mongrelization or displacement of the native stocks. This objection does not apply strongly to fur-bearing mammals introduced only into enclosures. Such stock would not ordinarily have any effect on the native stock, although breeders of fur-bearers should of course be cautious about extensive introductions until they are sure the results will be favorable to their own stock.

Another possible danger in the introduction of any foreign stock is that of bringing in new diseases. In order to show that this is not entirely a remote possibility I will state that I have found at least one case of skin disease on import cottontails from the west. Whether or not this particular disease is contagious, and if so whether or not it might be able to persist in the east, I do not know. However, some diseases of wild as well as domestic rabbits are known to be contagious.

From the standpoint of the scientific investigator the extensive transfer of native races is deplorable. Even now some doubts begin to arise as to the purity of race in the Pennsylvania and Maryland cottontails. The same thing is bound to happen with other species of animals of which foreign stock has been introduced. If introductions have to be made, it would be a great boon to have accurate records kept of the subspecies introduced and of the numbers liberated.

Lovers of the outdoors are interested in maintaining our native animals as nearly natural as possible. It seems to me just as desirable to preserve our native animals unmongrelized as it is to preserve some few patches of our native forests in virgin condition.

The introduction of a large number of individuals of any game animal of course increases the number of animals available for shooting in that season, but it is improbable that the increase is as great as would occur from the expenditure of the same amount of money in maintaining proper game breeding grounds. The native stock is presumably that best fitted for the conditions found in any state. The cottontail rabbit, especially, is an animal which will rapidly breed up its own stock if given any sort of chance. Except where a species is totally exterminated I should interpret the necessity of importing foreign stock into any state as a confession from the state game commission that they are unable or unwilling properly to care for their native breeding stock.

There are undoubtedly occasions where the restocking of a state from foreign sources is desirable, but in the case of the cottontail rabbit, and

probably for most other species, the introduction of foreign stock is unnecessary; it is undesirable from the standpoint of science and of the preservation of uncontaminated wild life; it may introduce contagious diseases; and it probably will cause the hybridization of diverse subspecies, leading to the production of mongrel offspring. I would therefore recommend caution, and before introducing mammals from other states I would advise a thorough study of the probable results by competent experts. Finally I would urge, if introductions are made, that complete records be kept of the subspecies brought in, of the source of origin, and the number of individuals introduced, and of the places of liberation.

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A CASE OF SUPERNUMERARY NIPPLE IN MACACUS RHESUS, WITH REMARKS UPON THE BIOLOGY OF POLYMASTIA AND POLYTHELIA[1]

By Carl G. Hartman

[*Plate 10*]

Through the kindness of the Rockefeller Institute for Medical Research, we recently acquired a full-grown mature female monkey (*Macacus*, sive *Pithecus*, *rhesus*), which possesses a good-sized accessory nipple. It is the object of this paper to place the case on record and also to point out for the readers of this journal the broader biological significance of polythelia and polymastia.

DESCRIPTION OF CASE

As seen in the accompanying illustration, the accessory nipple is placed below and a little mediad the left normal nipple. When the animal was held for the purpose of measurement, the arms were bent back and the skin of the chest thus unavoidably stretched and the nipples pulled out of their normal relation to the midline. In this condition they pointed somewhat laterad, whereas they are normally nearly parallel, with a slight droop when the animal is in the sitting position. In the former position the normal nipples were found to be attached 19 mm. from the

[1] Contribution from Department of Embryology, Carnegie Institution of Washington, Baltimore, Maryland.

midline, the accessory, 14 mm., and the distance between this and the normal nipple of the same side measured 22 mm. Normally, the nipples hang much closer, being about 28 to 30 mm. apart. The accessory nipple measures 6 mm. in diameter at the base and 8 mm. in length, against 8 mm. and 13 mm. for the corresponding dimensions of the normal nipples. All three nipples possess a terminal pore and are all probably functional.

This case is probably one of polythelia rather than polymastia, for the accessory nipple is far above what would be the caudal limits of the gland were it in an active condition. But being in the resting condition the gland could neither be seen nor felt.

OCCURRENCE IN PRIMATE ANIMALS

Thus far I have been able to discover only the following references to multiple nipples in primates other than man. R. Owen (1868, vol. 3, p. 780) states: "In an Orang-utan (*Pithecus satyrus*), I have observed an accessory nipple on the left side, below the normal one and of smaller size." Schickele (1899) made it a point to examine fifty monkeys. Among twenty-eight catarrhines he found one case (*Macacus cynomolgus*) but fails to state the exact location of the accessory structure. Among twenty-two platyrrhines one *Callithrix* and four *Cebus* females exhibited the anomaly. Sutton (1889) also states that he examined all of the monkeys that came under his notice (in London) and in a very short time secured two well-marked specimens. These he figures. They concern a *Macacus sinicus* female and a *Cercopithecus patas* male. The accessory mamma in the former and the accessory nipple in the latter are each below the normal left nipple, practically as in my own specimen.

So much for the apes and monkeys. In the Prosimiae or lemurs the situation of the mammae varies; they may be axillary or (and) pectoral, pectoral and abdominal, pectoral and inguinal, or pectoral, abdominal and inguinal. This is taken to mean that reduction of mammae is still going on in this group and it is probable that it is proceeding in different directions according to the diverging habits of the forms. The inguinal pair of nipples is often merely for "anchorage" (F. Wood Jones), since there is no mammary tissue in connection therewith.

OCCURRENCE IN MAN

Records of polymastia and polythelia in man are exceedingly numerous, the references in the literature being nearly five hundred (Deaver

and McFarland). The reasons for this interest are chiefly clinical, for accessory glands hypertrophy in the puerperium, exude milk to the discomfort of the possessor, and may cause pain by virtue of their swelling, particularly if the gland lacks an outlet. The accessory mammae, like other accessory organs, may be the seat of neoplasms; accessory nipples are, however, without importance in this respect.

Supernumerary mammae and nipples have doubtless been known from ancient times, if one is to judge from numerous classical statues of Venus which the artists provided with an accessory nipple on each breast, just above the normal one. In modern times Flechsig (1840) was the first to monograph the recorded cases. He was followed by Leichtenstern (1878), to whose list of one hundred and five cases Ahlfeld (1880) was able to add only a few from the literature. Bruce (1879), reported sixty-one of his own. Williams (1891), McGillicuddy (1891), Iwai (1907) and Hug (1908) added many others, and numerous observers reported individual cases, many of which were unique in point of situation of the gland or other circumstance worthy or record. Thus, for example, Neugebauer (1886) described a Warsaw woman who possessed, besides well developed normal mammae, eight accessory glands, the greatest number yet recorded for man; and all were functional after parturition.

As to the incidence of multiple nipples, estimates vary greatly. As implied above, the majority of the early reports concerned women; but Leichtenstern (1878), on the basis of his own cases and his study of the literature, expressed the opinion that the anomaly is as common in the male as in the female—at least one in five hundred. Bruce found sixty-one cases, male and female, in 3956, or 1.54 per cent. Among the Japanese, accessory mammae are estimated by Iwai (1907a) to be much more common than among Europeans, namely, 5.19 per cent for women, 1.6 per cent for men. The most extensive statistical study, however, is that of von Bardeleben (1893) who, on the basis of the examination of over 100,000 Prussian soldiers, states it as his opinion that 14 per cent of men (one in every seven!) have accessory nipples, pigmented areolae, or other representatives of mammary glands. The figures lose point, however, because of the obvious difficulty of differentiating between moles and nipples, ordinary pigment spots and areolae. Thus one observer reports five cases in a regiment of 3714 (0.14 per cent), whereas another observer, on the same material, reports 14 per cent, a hundredfold difference. In consequence, Hug and Schwalbe (Hug, 1908) made it a point to examine cadavers for accessory mammae and find two in

four thousand. Hathaway (1909) found 21 cases among 2561 male students of Cornell University, or 0.82 per cent.

Whatever the exact figures may be (and it seems that 1 per cent might be a conservative guess) it has been the experience of numerous observers that once the phenomenon is looked for, cases readily come to view in any clinic. But a sufficient number of exact figures is not yet available; hence it is premature to test Couvier's hypothesis, which holds that the variability in the number of mammae or nipples is a function of the total number characteristic of the species.

As cases thus multiplied, various contributing authors have felt called upon to give us summaries and interpretive monographs (Blanchard, 1885; Williams, 1891; Bonnet, 1893, 1897; Profé, 1898; Schickele, 1899; Wiedersheim, 1908; Deaver and McFarland, 1917), to which the present writer is indebted and to which the interested reader is referred for details.

NUMBER AND ARRANGEMENT

As long ago pointed out by Geoffrey Saint Hilaire, a single accessory mamma or nipple, as seen in our own case for example, is the condition found in the majority of cases; the asymmetrical considerably outweighs the symmetrical condition. Furthermore, the left side is affected in the majority of cases—seven to two according to Leichtenstern, but in smaller ratio according to subsequent writers. Yet the preponderance is always statistically to the advantage of the left side, which is in accord with the common observation that the left breast is normally the larger and gives the more milk.

Hyrtl, in his handbook of topographical anatomy, offers this physiological explanation of the frequent preponderance of the left breast: most women being right-handed, hold their infants in the left arm for nursing more often than in the right. However, unless one accepts the pure Lamarckian doctrine, Hyrtl's suggestion does not explain the fact that the left breast is also often the larger in young girls.[2]

The accessory structures usually occur below the normal mamma in European women (over 90 per cent, Leichtenstern), but in Japanese women usually above (82 per cent, Iwai). The number of cases studied is large enough to point definitely to a racial difference in this respect.

[2] In all three of our *Macacus rhesus* monkeys that have had young, however, the right breast and nipple hang lower than the left when the animal walks on all fours. One young, still nursing at the age of one year, uses the right nipple only, so far as we have observed it.

It is significant that if the accessory nipple is situated below the normal, it is found mediad; if above, laterad to the normal mamma. It is thus usually on the normal "milk line," as will appear below. Our own case corresponds to the rule.

In accordance with this rule a survey of described cases of supernumerary mammae shows that they are almost all found on the ventral surface, somewhere on the two lines that begin in the axillae, run over the thorax, and converge towards the inguinal region. (Cf. fig. 93, Merkel's Handbuch, 1899.) These constitute the mammary line and correspond to the line connecting the mammae of normally polymastic animals, like the dog or pig (Wiedersheim, fig. 13). In the Muridae the lines converge craniad also (Schickele, 1899), but this is only a developmental variation. Almost all accessory mammae are thus found where we expect them to be on embryological and phylogenetic grounds. The exceptions will be considered below.

Man, therefore, is viewed as the descendant of an ancestor possessing numerous mammae, a concept that goes back to that noted precursor of Darwin, Geoffrey-Saint Hilaire (1836). Darwin's viewpoint (1871) was at once accepted as the most reasonable explanation; hence we find Leichtenstern, in 1878, elaborating upon the atavistic nature of the phenomenon, as summarized by Darwin (1871) in these words: "On the whole we may well doubt if additional mammae would have been developed in both sexes of mankind, had not his early progenitors been provided with more than a single pair."

Attempts have been made to reconstruct the mammary apparatus of man's hypothetical ancestor. H. Meckel (quoted by Leichenstern and Neugebauer) postulates five mammae, including one median gland; Blanchard (1885) presupposes three pairs; Williams, seven pairs, of which the normal mammae are thought of as constituting the middle pair. Williams' scheme ignores abdominal, inguinal, and crural cases. Wood Jones (1908) takes no chances and gives our ancestors twenty-two pairs, the largest number found in the Eutheria (*Centetes*). The largest number in mammals, twenty-five, is found in the Australian marsupial, *Peromys henseli* (Bronn's Tierreich).

THE RECAPITULATION THEORY AND OTHERS

Various theories have been advanced to explain polymastia and polythelia. Williams (and Oken and Meckel before him) would derive accessory mammae through incomplete fusion of the lactiferous ducts which normally would go to a given nipple. Hansemann thought the

multiple structures to be divisions of the original mammary rudiments. Ahlfeld proposed adhesions of the amnion, which later drag the mammary rudiments out of place and cause a kind of spontaneous transplantation. Certain writers (Duval, Champneys, 1886; Bacon, 1902) considered certain axillary swellings as hypertrophied sebaceous glands, while Seitz (1909) referred these swellings to sweat glands. Seitz saw in sections of these "tumors" every transition between normal sweat glands and true mammary tissue. These observations of Seitz are of special interest from the standpoint of the homology and phylogeny of the mammary glands. The prevailing opinion (including that of Breslau and of Gegenbauer) favor the sweat-gland theory. The accessory axillary glands of Seitz are structures "arrested in development, but continuing to grow" (Darwin), the "arrest" and the "growth" occurring in various proportions.

The explanation of Seitz may well hold for certain axillary growths, especially those without nipples or such as exude a whitish fluid from numerous pores. But that true mammary glands, completely functioning, do occur in the axilla is proved by numerous authentic observations, particularly those in which the glands were studied both in life and after removal (Hintze, 1897; von der Heide, 1911).

The most rational explanation for accessory mammae, however, dates from O. Schultze's discovery, in 1892, of the "milk-line" of mammalian embryos. The discovery was quickly extended to man (Schmidt, 1897; Kallius, 1897; Schmitt, 1898; Brouha, 1905). In a 15 mm. pig there appears on each side of the body an epithelial ridge extending from the axilla to the angle of the posterior limb bud. A little later swellings appear in the ridge at given intervals, the so-called milk points. These disappear, however, and have nothing to do with the mammae except that they mark the site of the segmental mammary "knobs" or pockets which soon grow downward from the epithelium to form the definitive milk glands, normal and accessory. The embryo is thus always polymastic, even though normally most of the rudiments disappear. In consonance with this now current "milk-line" or "milk-streak" (Breslau) theory, the incidence of polymastia in the embryo is greater than in the adult (Burckhardt, 1897).[3]

It happens, however, that accessory mammary glands occur certainly, though rarely, in situations outside the milk-line: on the thigh, the neck,

[3] Not all epithelial thickenings mark mammary rudiments, however, for there are many outside the milk-line (Schmitt, 1898; Walter, 1902) which still await explanation.

the back. Although these do not seem to fit into the above described scheme, yet it must be remembered that in the embryo, say in the 9 to to 15 mm. pig or the 15 to 60 mm. human embryo, the milk-line lies quite dorsad, indeed very near the midline, and runs caudad well on to the hind limb bud. It is quite reasonable to suppose that a mammary rudiment is easily left behind, through irregular development, for which presumption there are numerous analogies.

In this connection it should be pointed out that in the various mammalian orders mammary glands are normally found in situations outside the milk-line: on the back in certain hippopotami; on the side of the genital opening in the Cetacea; two pairs on the thighs in the rodent *Hypudaeus*, etc.

There remains, however, yet to be explained, those extremely rare cases of far-flung glands, such as those reported on the ear, the face, and the arm. The two or three authentic cases of mammary glands in the midline find their exact, though quite distant, phylogenetic parallel in the median gland of the Marsupialia.

It is thus seen that in the progressive reduction of mammae we have another example of the biogenetic law: phylogenetically the primates, originally polymastic, become bimastic by reduction in the number of functional mammae, and this process is recapitulated in the ontogeny of all primates, including man, by the appearance of rudiments in the embryo. Occasionally, as a reversion or "atavism," the adult retains at one point or another a persistent example of the ancestral condition. Stated in modern genetical terms, the primates have not yet become absolutely homozygous for the bimastic condition.

HEREDITY

Some writers scoff at the notion that the anomaly of polymastia or polythelia is an hereditary transmissible character (e.g., Williams, 1891). It is certain, however, that this viewpoint is erroneous and that we must answer the question in the affirmative, as did Flechsig, as early as 1840, when asked: Why should not accessory mammae be as subject to the law of heredity as the characteristic facial moles that betrayed the members of Cicero's family and those of Lentulus' family, or as the unique and imposing nose of the Ovidii? The cases cited by Deaver and McFarland and numerous others in the literature amply testify to the hereditary character of the anomaly. The two more complete family histories are those of Marie (1893) and Klinkenfuss (1924), both records involving four generations. The latter is

readily available to American readers. Doctor Marie's patient and her eleven brothers and sisters had a supplementary nipple, all on the left side except in the case of one sister, who had a large accessory breast on the right. Her father and five of his brothers had an accessory nipple on the left, but eleven other uncles and aunts had none. The paternal grandmother had the accessory nipple on the left, the great grandmother on both sides: twenty cases in four generations, eighteen out of twenty-eight children in two generations.

Observations upon animals have proved the hereditary character of supernumerary nipples, and Wentworth made some breeding experiments on pigs, which demonstrate a kind of sex-limited inheritance, in that both homozygous and heterozygous males, but only homozygous females, possess the particular accessory nipples under consideration. In the case of sheep, Profé examined over 446 embryos and adults and found never more than two accessory nipples; he makes no mention of any of them being functional. Nevertheless, Alexander Graham Bell succeeded in breeding up by selection a strain of sheep, 90 per cent of whose offspring possessed two to four accessory nipples, *all functional.*

POLYMASTIA AND FECUNDITY

The Greeks represented Diana of Ephesus, Goddess of Fertility, with a cluster of numerous breasts. Whether the sculptor reflected the popular belief that polymastic and high fertility, including multiple births, are related phenomena is by no means proved (Neugebauer, 1886); yet it is certain that the notion is deeply rooted in the folklore of the people, as illustrated by the following story, told by Percy (1804): An old physician (Doctor Socin) of Basel was consulted by a rich young heiress, who was the unhappy possessor of four breasts. She wished to know whether, in the event of her marriage, she ran the risk of having quadruplets or triplets, a fear instilled into her through old wives' tales. The venerable doctor answered in the negative. Not satisfied, the family, "d'un de plus opulentes et des meilleures maisons de Suisse," addressed the same question to the medical faculty in Tübingen and received the same answer. "Notre demoiselle quadrimamme s'est mariée et elle n'a même jamais eu une couche double."

It is possible that the tradition that multiple births and supernumerary nipples go together arose from observations upon domestic animals and that there is no genetic relation between the two phenomena within the same species. But for man, numerous cases can be adduced from the literature. Iwai (1907b) believes he has established a correlation for

Japanese women. In the case of Doctor Marie, quoted above, the patient's father was a twin and there were two other pairs of twins in his sib; there were two pairs of twins in her own sib; a twin uncle had one pair of twin sons.

It has been shown in this brief review that other primates display polymastia and polythelia as does man. It is hoped that naturalists will be less likely to pass such anomalies by as mere "freaks of nature," as was done a hundred years ago, but will look upon the anomalies in the light of the underlying laws of development and evolution, which they exemplify.

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THE TRADE IN DEER SKINS IN EARLY TEXAS

BY JOHN K. STRECKER

In Texas, in frontier days, the deer skin was a medium of exchange between whites, as well as the "currency" par-excellence between red men and white. As custodian of the special collection of material relating to Texas in Baylor University Library, I recently came into possession of a large number of records and papers which once belonged to George Barnard, who established a number of Indian trading posts in central Texas when that section of the state was still in the hands of the aborigines. Barnard was a Connecticut Yankee born in Hartford, a man of considerable education and refinement. He came to Texas about 1838, three years later joined the Texan Sante Fe expedition, suffered captivity in Mexico, and afterward returned to Houston, where he became identified with the Torreys in trading relations with the Indians. He was therefore one of the pioneer Texans and a veteran of the wars of the Republic.

The Torrey brothers, David, John, James, and Thomas, were also Hartford men—boyhood school-mates of Barnard. James was one of the Mier expedition prisoners and was killed by the Mexicans for overpowering a guard and attempting to escape. Thomas, who was a survivor of the Sante Fe expedition, died of a fever while he and Barnard were locating sites for trading stations, between the present site of Waco and the falls of the Brazos River. Capt. John F. Torrey finally settled near Torrey's peak in what is now Hood County, Texas, dying there in the late eighties. David remained in Houston, but I am unable to find any record of his later life. David and John F. were the chief

organizers of the frontier trade with the Texas Indians. In accordance with a treaty entered into with the Republic of Texas, the Indians were to permit the establishment of a number of trading posts in the central and southwestern sections of the state, which at that time were really in Indian country.

Barnard established trading posts at a number of different points. First, on the "Navasot" (Navasota River), between that stream and the Brazos River; second, on Trading House Creek, eight miles southeast of Waco; third, near the falls of the Brazos River, not far from the present town of Marlin; and fourth, in Hood County, near Weatherford. As a member of the Torrey company, he was also interested in trading stores at New Braunfels and Fredericksberg. We have papers which indicate that he was also interested, either as principal or backer, in enterprises at Fort Belknap, Fort Graham, and other places, but these were later ventures, doubtless engaged in long after he severed his business relations with the Torreys (1848).

Torrey and company maintained stores at Houston, Austin, and San Antonio during the forties. To what extent Barnard was interested in these branches, the papers and documents at hand fail to furnish a clue. Many prominent Texans of this time were financially interested in the Torreys' trading ventures. Among these were Gen. Sam Houston, who was one of the presidents of the Texas Republic, later governor of the state, and afterwards United States senator for many years. We have receipts, acknowledging the delivery of bundles of deer skins, which were signed by him.

From 1844 to 1847, Barnard was almost alone in the Indian country at Trading House Creek and during this time his shipments of skins were rather infrequent. L. H. Williams conducted a freight line between the trading house, the last outpost of civilization, and Houston, carrying goods by means of ox wagons. About once every sixty days, he hauled Barnard's skins to Houston and on the return trip brought provisions and trade goods.

When the Indian trader was alone, he filled in his time by preparing his skins for the market. He arrayed himself in a single garment, usually a long-tailed shirt, and went after the task of beating out insects in true aboriginal fashion. Commencing with the year 1848, after the country had become more thickly settled as a result of the influx from other states, he often made a good-sized shipment of skins every thirty days.

His shipments consisted for the most part of deer skins, both rough and

dressed, but he also handled buffalo hides, bear, beaver, coon, and fox skins. Judging from the records still extant, he must have shipped during the period from 1844 to 1853, from the Trading House Creek post alone, not less than 75,000 deer skins! In the three years from 1851 to 1853, the number amounted to 33,891 (actual figures furnished by his invoices), so that there is no question but that I have underestimated, rather than overestimated, the figures for the ten-year total.

The deer of the central portion of the great state of Texas was the small Texan deer. This animal must have been excessively abundant before the country was settled by the whites. The early traders speak of great herds of deer and antelope numbering into the thousands, something that we moderns can hardly conceive of. Maj. George B. Erath, one of the pioneers of Waco, in his memoirs published by the Texas State Historical Association, says that in former years it was a common thing to encounter small herds of antelopes in the region now comprised in McLennan, Falls and Robertson counties, but he asserts that this animal was never found in this section in as great numbers as in the Staked Plains region. However, he and other authorities agree that buffaloes and deer were very abundant in central Texas.

Probably the earlier shipments of skins from Trading House Creek were at Houston combined with those from other trading houses; but after Barnard set up in business for himself, his bales were sold at auction in New York by Messrs. Grant and Barton, commission furriers.

During the early fifties, the trader received from fourteen to sixteen cents per pound for good rough skins, but worm-riddled skins were hardly worth the expense of shipping. Dressed skins brought from seventy-five cents to one dollar each, the cheaper grade being baled, while the "number ones" were sold by the dozen. There was not a very great profit in rough skins, for the Cherokee, Delaware, Waco, and Tehuacana Indians (these being the tribes which did most of the business at Trading House Creek) received an allowance of from twelve to fifteen cents per pound in trade for them.

In shipping to New York there were various expenses to be considered, those things which now would be included as "overhead," such as brokers' commissions, marine insurance, freight and charges, health officer permit, cartage, weighing, storage and labor, and fire insurance. An average bale of rough deer skins weighed about two hundred and ten pounds. A rough skin of the small Texan deer weighed between one and one-half pounds. The skin of an unusually large buck might weigh a fraction more than my maximum estimate. One lot of 972 dressed

skins weighed 847 pounds. Sometimes rough skins were called "hair skins" and dressed skins were often listed as "shaved" skins.

The following items from Barnard's invoices from May 1, 1851, to April 20, 1853, will give some idea of the number of skins he handled at Trading House Creek during this period:[1]

1851, May 1st	For amount of skins bought and shipped since first Jan'y to Mess. Grant and Barton, New York, 12,000 lbs. @ $.15	$1800.00
" "	1 Bale dressd. skins cont. 23 doz. @ $12	276.00
" "	1 Bale Bear skins 40 @ $1	40.00
1852, May 24	Net proceeds 17 Bales skins acc. sale Jan. 12, 1852	777.66
" "	Net proceeds 25 Bales skins acc. sale Feb. 5, 1852	1091.86
August 1st	Net proceeds 6 Bales skins acc. sale June 2, 1852	231.37
" "	Net proceeds 39 Bales skins acc. sale June 15, 1852	1123.87
" "	Net proceeds 11 Bales skins acc. sale April 16, 1852	505.35
" "	Bear, Raccoon, etc.	73.66
" "	Net proceeds 974 dressd. skins acc. sale July 20, 1852	706.82
Nov. 1st	Net proceeds 1605 dressd. skins acc. sale Sept. 7, 1852	1252.09
" "	Net proceeds 973 dressd. skins acc. sale Sept. 7, 1852	825.73
" "	Bear, Raccoon, and other skins	60.00
1853, March 10	Net proceeds 6139 lbs. deer skins and 972 dressd. skins acc. sale Jan. 22, 1853	2109.66

A notation under date of April 20, 1853:

Ship to New York	
25 Bales deer skins	5000 lbs.
1 Bale Bear skins	35 lbs.
1 Bale Coon and Fox	175 lbs.
1 Bale Dressd. Deer	20 doz.

These figures indicate that in twenty-eight months, Barnard shipped approximately 43,910 pounds of rough deer skins, 4,800 dressed deer skins, nearly a hundred bear and a miscellaneous lot of raccoon and gray fox skins. And all of these were shipped from one of his establishments

[1] Several sheets, covering more than half a year, are missing.

and he is known to have been financially interested in a dozen or more at different times. In the forties he handled a number of beaver skins for which he received $1.00 each in the New York market. Bear skins ranged in price from $1.00 to $3.00 each at this time. He also sold a few antelope, bobcat, leopard cat (ocelot) and opossum skins.

George Barnard died at Waco, March 6, 1883, universally respected and beloved. He was undoubtedly the first man to settle in what is now known as McLennan County, and can be called, without danger of contradiction, the father of the thriving city of Waco. He was one of the wealthiest men in central Texas at the time of his death and the foundation of his fortune was trade in the skins of deer and other wild animals while the Indians still held sway in the fertile valleys of the Brazos and Bosque rivers.

Baylor University, Waco, Texas.

OBSERVATIONS ON YOUNG PRAIRIE-DOGS (CYNOMYS LUDOVICIANUS) BORN IN THE LABORATORY[1]

By George Edwin Johnson

[*Plates 11–13*]

On the first day of April, 1925, the writer found four young prairie-dogs which had been born since the previous day in a nest box in a laboratory cage about three feet square occupied by a pair of adult prairie-dogs. Since no account of breeding by prairie-dogs in the laboratory has been found and no description of the young beginning with the day of birth appears to exist, the records taken in this case should be of scientific interest. The date of birth of the young prairie-dogs and the ages at which they respectively open their eyes, are able to crawl out of the burrow, and are able to subsist without their mother's milk, are of practical importance. Control or eradication measures can best be applied when the complete life history and all the habits of the prairie-dog are known.

The parent prairie-dogs had been received from Medicine Lodge, Kansas, in October, 1924. As they were adults at that time, they must have been two years old or more when the young were born. Other

[1] Contribution No. 84 from the Department of Zoology, Kansas State Agricultural College.

animals, also adult, received in the same shipment had died as a result of injuries evidently received from traps used in catching them, or, on account of their injuries, had been used in poison experiments. Because of their age and their bruises received from traps the two remaining prairie-dogs did not become tame during the winter of captivity and even by spring usually made frantic efforts to escape if one attempted to touch them.

Early in March, the scrotal position of the testes in the male and the enlarged elevation around the urogenital aperature in both sexes suggested sexual activity. How much earlier these appearances had been present is not known. In 1926, similar indications of sexual activity were seen as early as January second and continued through most of February in the majority of the seventeen laboratory animals.

Both parents were found with the little prairie-dogs in the nest box near the back of the cage. While the male showed no inclination to disturb the young, it was thought best to remove him to another cage so that he could not step on them. This was done. The female covered the young and seemed solicitous about them, licking them or rubbing them with her mouth. This reaction was similar to that seen in ground squirrels and possibly had to do with the cutting of the umbilical cord. As the mother was moved about so that the young might be seen, she bit a pencil and tried to bite the attendant's fingers. In doing this she remained in a sitting position and did not trample on the young. One of the four young was picked up and studied. It was quite active, aimlessly rolling about. It weighed 15.5 grams and measured 69 mm. (2.75 inches) in length from tip of nose to base of tail, and 82 mm. (3.25 inches) from tip of nose to tip of tail. The mouth was large and had reached a much higher degree of development than the remainder of the body. The ears were indicated by very slight irregularities in the skin at the upper lateral and posterior parts of the head. The skin was dark red and very wrinkled. It was smooth and shining between the wrinkles. Cross wrinkles suggested the appearance of some of the relatively hairless thick-skinned mammals like the elephant or hippopotamus. Other features, such as the presence of very short digits and short tapering tail, may be observed in plate 11, figure 2, which is reproduced from a photograph taken when the animals were one day old.

About fifteen minutes after the first observations were made on the mother and young and after the father had been removed to another cage, the mother was seen coming out of her nest. She went to the

inverted water bottle used as a fountain and drank from the end of the glass tube inserted in the stopper of the bottle. She continued drinking for perhaps a minute. Then she ate a little green alfalfa and went to the dish containing oats. After taking a look around she fed rapidly for five or six minutes, then apparently disturbed by a movement made by the observer she went back to her nest and stood over the young. They had been rolling about while she was off the nest. This movement seemed to be accomplished mostly by the muscles which were responsible for the changing of the relative positions of the head and the remainder of the body, and by the legs.

Photographs of the four young prairie-dogs were taken at intervals of several days to show the change of form and appearance. Their almost constant movement made it very difficult to photograph them successfully. The first four pictures (plate 11 and plate 12, fig. 4) were taken in strong artificial light by the Illustrations Department of the Kansas State Agricultural College. The remainder were taken in sunlight with a Graflex camera by the author.

At seven days of age the young prairie-dogs showed a considerable increase in size, having gained forty per cent in weight, but there were no other marked changes. At thirteen days they were about two and one-half times as heavy as when born. They now had hair on the nose and the tactile hairs, first seen at eleven days, were developing. Fine hair covered the cheeks and there were a few hairs on the body. The eyes and ears were developing but were not yet open. The eyes were bulging out under the skin and the external ears were forming as a fold of the skin, but the external auditory meatus was not yet visible. Little further change was noted by the sixteenth day (plate 11, fig. 3). By this time they could utter a squeaky protest when held in a position unsatisfactory to them. They sprawled about and rolled about considerably. The head and fore legs were large and more developed than the posterior part of the body. On their twentieth day they had hair over the body. It was short and dense on the head, short and moderately thick on the back, and sparse on the abdomen. The dorsal side was deeply pigmented. One animal was almost able to stand. At twenty-six days of age the animals were well covered with hair, which was short underneath the body. They could crawl with the legs spread out at the sides of the body. They would roll over occasionally and turned around much instead of going forward in a straight course.

The eyes did not open in any of these young prairie-dogs until they were from thirty-three to thirty-seven days old. On the first of these

days the largest female had one eye open and on the last the smallest male still had one eye closed. From this it would appear that young prairie-dogs open their eyes when approximately five weeks old. By this time they showed some fear and the picture reproduced in plate 12, figure 4, was obtained only after holding the animals down under both hands and then gradually removing the hands and taking the

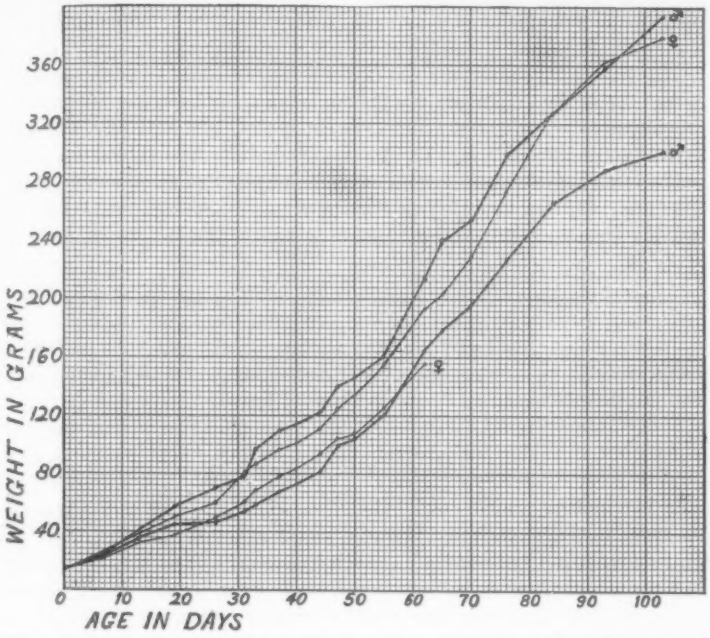

FIG. 1. GRAPH SHOWING GROWTH CURVES OF YOUNG PRAIRIE-DOGS BORN IN THE LABORATORY

picture before they began to move about again. This picture was taken on the thirty-third day when one animal had one eye open. The open eye is not seen in the picture, however. It is to be noted that there is considerable difference in size, and reference to the graph (fig. 1) giving the weights of the young prairie-dogs shows that the smallest animal weighed 59 gms. and the largest weighed 99 gms.

With the opening of the eyes came the ability to walk and run well all

about the cage. They ate a little green alfalfa. They could "bark" when disturbed. They could now be recognized as real prairie-dogs, small in size. By the time they were forty-three days old (plate 12, fig. 5) the hair had grown considerably longer, the body had increased in size noticeably more than the head, giving more the proportions of adult prairie-dogs. They would run rapidly in order to avoid being caught. From these observations it would appear that young prairie-dogs could not appear above ground before they are five weeks old and probably do appear first before they are six weeks old.

That the larger male and the larger female of the four young prairie-dogs born in the laboratory were about normal size on their fiftieth day is suggested by a comparison with two young received on that date from Lyons, Kansas (plate 12, fig. 6). These, also a male and a female, had been caught about three days previous. The male weighed 114 gms. as compared to 147 gms. for the largest laboratory raised male, and the female weighed 134 gms. as compared to 135 gms. for the largest laboratory raised female. However, the fact that the young caught in the field were thin and had a slightly larger body frame gave evidence that they would have been slightly heavier than the laboratory raised animals, had they not been without food in transit and possibly before being caught, for it is probable that the mother had died as a result of eating poisoned bait.

It is of interest to note that these wild young animals resisted handling much more than the ones reared in the laboratory. The male was very cross and could bite through the skin of one's finger. They were placed with the mother prairie-dog so that their reactions and hers might be observed in this situation. The wild young male was cross with all the other young, but both of the new young were accepted into the family by the mother after she had smelled of them, or at least held her mouth to theirs. As the young male secured hold of a teat she proceeded to lick it, clearly showing no aversion to the strange young animals.

One striking difference between the wild young and the ones born in the laboratory was that the hair of the former was much coarser and somewhat darker than that of the latter (plate 12, fig. 6). Apparently the outdoor environment stimulated a coarser and darker growth than did the conditions in the laboratory. The laboratory animals gradually became somewhat darker but their hair remained quite fine for some time as may be seen from the illustrations.

With the opening of the eyes came the necessity, increasing day by day, of subsisting on food other than their mother's milk. For this or

FIG. 2, a. YOUNG PRAIRIE-DOGS ONE DAY OLD

FIG. 2, b. YOUNG PRAIRIE-DOGS ONE DAY OLD, ONE SHOWING FORM AND RELATIVE SIZE OF MOUTH

FIG. 3. YOUNG PRAIRIE-DOGS SIXTEEN DAYS OLD

FIG. 4. PRAIRIE-DOGS THIRTY-THREE DAYS OLD

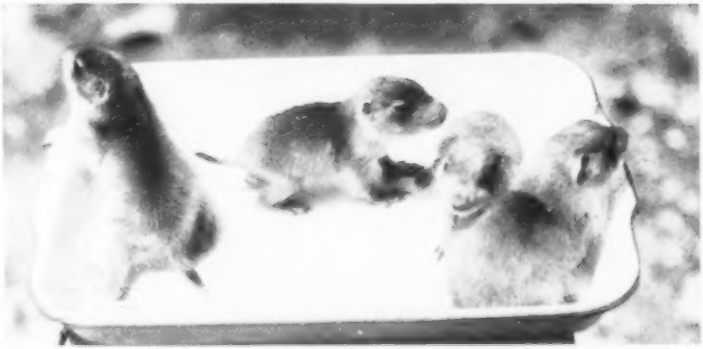

FIG. 5. PRAIRIE-DOGS FORTY-FOUR DAYS OLD

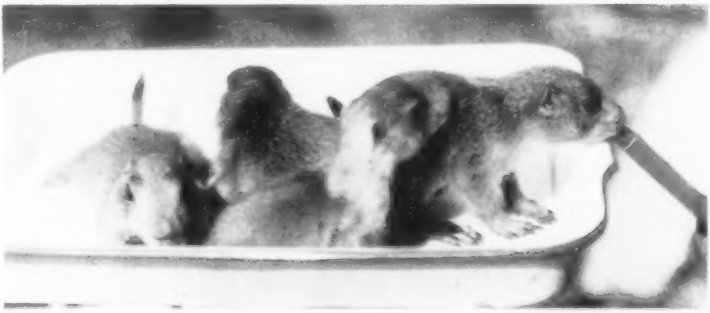

FIG. 6. YOUNG PRAIRIE-DOGS

At the left and in the foreground are laboratory raised animals fifty-two days old. The others are wild young of unknown age. Note the fine hair of the former and the rough hair of the latter.

FIG. 7. PRAIRIE-DOGS SEVENTY DAYS OLD

FIG. 8. PRAIRIE-DOGS SEVENTY-SEVEN DAYS OLD

FIG. 9. PRAIRIE-DOGS EIGHTY-EIGHT DAYS OLD

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for other reasons one of the smaller ones died when sixty-three days old. The other three (plate 13) grew well for some weeks. Only the largest male, however, lived through the autumn. The cause of the death of the others is unknown. At nine months of age the surviving male weighed 947 grams and was in excellent condition.

These observations, supplemented by an examination of three pregnant females in the field, indicate that in Kansas in the year 1925 the young of prairie-dogs were born early in April. The observations also show that young prairie-dogs open their eyes when about five weeks (33 to 37 days) old, that they can not appear at the entrance to the burrow before they are five weeks old and probably do appear some before they are six weeks old. The observations further indicate that young prairie-dogs are probably not able to survive without milk from the mother until after they have attained the age of seven weeks.

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A STUDY OF THE PELVIC GIRDLE OF 20-MM. EMBRYOS OF THE MOLE, SCALOPUS AQUATICUS MACHRINUS (RAF.)

By Frederick L. Hisaw and Marion L. Zilley

INTRODUCTION

The mole, like other burrowing mammals, shows marked differences from the general mammalian form, modifications which adapt it to its subterranean habits. These adaptations have been studied by Chapman ('19), Slonaker ('20), Hisaw ('23) and others. The most prominent of these adaptations are degeneration of the eyes, a great increase in size of the pectoral girdle and anterior limbs, and a relative reduction in the pelvic girdle and posterior limbs. This is accompanied by a shifting in position of the urogenital canal and of the posterior part of the alimentary tract.

Slonaker says that the greatest variation found in the pelvis of the different genera of Talpidae is in the region of the pubic symphysis, which varies from a well-formed symphysis to a relatively wide gap between the pubic bones. In *Scalopus* the pubes form a symphysis which extends for a distance of 3.8 mm. parallel with the long axis of the sacrum. Jackson ('15) found that in *Scapanus* the bones of the opposite sides of the pelvis scarcely touch in the region of the pubis.

In a specimen of *Scapanus* examined by Slonaker the pubes met for a distance of 0.5 mm. This union was due to slight projections on the medial side of the pubes, and occupied a position corresponding to the anterior end of the symphysis in *Scalopus*. The European mole, *Talpa europaea*, has been studied most frequently and it is generally agreed that in this species the pubic bones are quite widely separated. These facts have been so generally known that it has become customary to speak of the mole as having no pubic symphysis. In cases where Slonaker speaks of moles having a pubic symphysis, he is probably referring to a secondary joining of the pubic bones, for the alimentary and urogenital tracts pass ventral to it.

MATERIAL

The material used for this study consisted of twenty-millimeter embryos and four litters of young, ranging from one taken soon after birth to one that was more than half-grown. The posterior halves of two embryos were sectioned at ten microns and stained in Heidenhain's iron hematoxylin. Outlines of the pelvic bones were traced by means of the camera lucida and reconstructions were made from these, by accurate measuring of the drawings, to give a lateral view of the pelvic girdle.

DISCUSSION

The embryological development of the pelvic girdle is essentially the same in all mammals. The first fundaments of the pelvis are a right and left pelvic cartilage united ventrally at the symphysis pubis. Each pelvic cartilage is composed of an expanded part extending dorsally, the iliac cartilage, in close proximity to the sacral region of the vertebral column and two ventral cartilaginous rods, the pubis and ischium, which, meeting at the symphysis pubis enclose the obturator foramen. The ilium, ischium, and pubis are gradually formed by ossification, but there is much cartilage left at birth.

The reconstruction made from the sections of the embryo mole (fig. 1) shows that the general shape of the pelvic girdle corresponds to the usual mammalian type. The obturator foramen and acetabulum are well formed. The pubic region is represented by a well developed cartilaginous arch, meeting ventrally, so that the urogenital and alimentary canals lie within the pelvic outlet. This cartilaginous arch does not become ossified, like the rest of the bones of the pelvic girdle, and in the adults of this species, both the male and female lose the true

symphysis (fig. 3). It is possible to recognize the former position of the pubic arch in half-grown moles (fig. 2) by the presence of a fibrous band that unites two cartilaginous points, which are remnants of the embryonic, cartilaginous pubic arch, with the rectus abdominis muscle. Leche ('80) states that 35- to 40- mm. embryos of *Talpa* have a cartilaginous band which connects the posterior angles of the pubic bones and that the urogenital and alimentary tracts pass through this open space

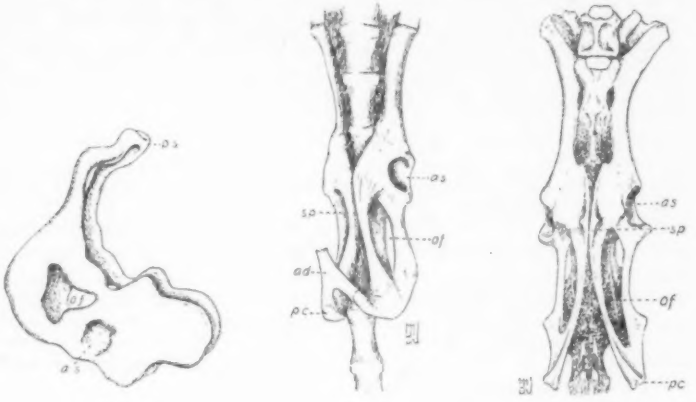

FIG. 1 FIG. 2 FIG. 3

FIG. 1. A RECONSTRUCTION OF THE PELVIS OF A 20-MM. MOLE EMBRYO
as, acetabulum; *of*, obturator foramen; *ps*, pubic symphysis

FIG. 2. PELVIS OF A HALF-GROWN MOLE
Cartilage is shown by stippling and bone by lines. *ad*, rectus abdominis muscle, *pc*, unresorbed base of pubic cartilage; *sp*, position of secondary pubic symphysis.

FIG. 3. PELVIS OF AN ADULT MOLE
Labeling as in figures 1 and 2

in an entirely normal manner. He also describes a pubic ligament in the embryos of Soricidae, which, if the complete development were known, perhaps represents the position of a previous cartilaginous pubic arch.

In the adult moles that Chapman ('19) studied, he found the "star-nosed" mole (*Condylura cristata*), *Scapanus townsendii*, *Scalopus aquaticus*, *Talpa europaea*, and *Urotrichus* sp. lacked the pubic symphysis.

A similar condition was reported by Bronn ('74) for shrews while it has been claimed that in hedgehogs the pubic symphysis is very short and consists of a cartilaginous arch. The senior author ('25) has shown that although the pubic bones of the pocket gopher, *Geomys bursarius*, are completely ossified and meet at the symphysis in both males and females, those of the latter are almost completely resorbed at the time of sexual maturity. Thus the pubic symphysis in certain burrowing animals seems to be in a process of reduction and these observations show that in the mole these adaptations are modifications, during embryological development, of a pelvic girdle of the usual mammalian type and it is highly probable that a true pubic arch is formed in the course of embryonic development in all these cases.

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PHOTOGRAPHING BEAVERS

By Tappan Gregory

[*Plates 14–15*]

Beavers have always been to me among the most interesting of wild animals. I have often tried to photograph them from a boat by flashlight, but my experience has shown them quite shy under the light of the "jack." Last fall (1925), I had the good fortune to be in the woods in Marquette County, Michigan, at the same time that Vernon Bailey was there, and he made some valuable suggestions as to the use of poplar saplings in connection with the camera. I first set out my camera in an effort to get pictures taken by the beavers themselves, on the fifteenth of September, completing the set late in the afternoon, the place chosen being a spot on the soft, marshy ground, washed by the waters of Pine River, a few hundred yards above where this stream flows into Lake Superior. Here the tall grass had been flattened down by beavers. There were several places like this, not far apart, which they apparently used every night as feeding grounds. I cut a poplar sapling of perhaps two inches in diameter and a length of six or seven feet and trimmed off all the branches. One end of it was then embedded a few inches in the boggy ground so it could not be taken away by beavers without being first cut down. I sloped it slightly away from my camera to guard as well as might be against the possibility of its falling in the wrong direction and attached one end of a trip wire to the sapling near its top, fastening the other to a copper plate which formed one side of a break in an electric circuit. The wire was high enough so that there was no possibility of the beavers running into it except near the break in the circuit and the angle at which it was led to the sapling was such that I felt well assured of the unlikelihood of the flash being set off except by pressure upon the poplar itself. The amount of pressure required could be easily varied by changing the tension of the wire and the width of the gap in my electric circuit, offering a choice in the possible variety of pictures; having some of them show the beaver at work and others taken when the poplar was falling. One other camera was set out that evening in similar fashion. At both of these sets poplar twigs and leaves were placed on the ground around the saplings. Poplars no longer grow within beaver range of Pine River, so it seemed reasonable to hope that our saplings would prove peculiarly attractive to the beavers. At eleven o'clock that night the

sound of the discharge of flash powder at one of the sets was heard, though, of course, it was impossible to tell which one. I visited mine at seven the next morning and found the sapling cut about half-way through, six or eight inches from the ground. All except one of the boughs left on the ground the night before were gone. The bark around the bottom of the poplar had been chewed off, the flash-light discharged and a picture left on the plate. Development showed a beaver in the act of cutting, with back towards the camera, both fore feet on the sapling, one above, the other below its mouth. It looks from the picture to have been a good-sized full-grown individual. Returning to the set later in the day, I made ready the apparatus for another effort, having completed preparations by about 5:30 p.m. I left the poplar standing and made no change in the delicacy of the trip. Owing to the fact that the first picture appeared slightly underexposed, the charge of flash-powder was increased from one-half to three-quarters of an ounce normal speed.

A trip to the set the next morning in the midst of soaking rain, thunder and lightning, disclosed that beaver had visited the place and stripped the small boughs at the foot of the upright sapling, but the latter was untouched and the flash not discharged. The storm continued with a strong southerly wind for several hours in the morning, sending the temperature up considerably, the thermometer registering 75°F. at 6:30 that evening, and by 9:30 only some five degrees lower. On the whole, the apparatus withstood the rain quite well, so that it was possible for me to reset it in the afternoon without disturbing the general layout. When I made my rounds in the early morning of September 18, I found the little poplar branches again stripped, the sapling cut off at the old notch and carried away, and the stub severed flush with the ground and partly stripped of its bark. The flash had been discharged and the resulting picture was one of great interest to me. Here stood a well grown beaver by the upright stub of the poplar and by the water's edge appeared a smaller beaver. The larger of the two animals quartered toward the camera in cutting the sapling, and when the work was done, the log fell in such a way that it struck apparently across the neck and shoulders of the smaller beaver, just as the flash was discharged. The record indicates that only then the one which had done the cutting abandoned its upright position and reached again for the ground with its fore feet. I wish I might have watched the whole proceeding, so that I could know what the little beaver did when it recovered from the shock, whether these same two animals remained

on the spot after the flash or returned to remove the stub of the poplar and how the larger one conducted itself while the sapling was falling. But it is useless to indulge in idle conjecture.

When I came again to reset the camera at six o'clock that evening, the water in the river had risen several inches, due to the partial closing of the mouth caused by the action of a north wind which had been blowing all day. That day had given me a most interesting trip with Vernon Bailey, reviewing the beaver situation on two or three nearby lakes, at one of which, during the course of our travels, we surprised a mink and sent it scurrying across the top of a newly discovered beaver house in process of construction. The success of the last three nights deluded me temporarily into hoping for quite a series of pictures, but it was not long before I was disillusioned and made once more to realize that one or two good pictures in every three or four weeks of set-camera work is all that can be reasonably expected. The weather continued mild, but it rained again the next day and while I found the branches and leaves at the set stripped and eaten and the flash discharged, the poplar was untouched and I was satisfied that, owing to the high water, it had settled enough to cause sufficient tension of the wire to close the electric circuit. Intermittent heavy thunder showers until about midnight of the nineteenth and a strong northwest gale all day the twentieth did not help matters. The river rose during that day a foot or more, leaving no dry land available for access to the bait sapling. It had been gnawed at the bottom the night before and then cut two-thirds or three-quarters of the way through, a few inches above. This brought sufficient pressure to bear, of course, to give me a picture with just a suggestion of the beaver at work, but it was worthless because of mist or rain or perhaps a combination of both. One cause of serious difficulty in taking pictures here, was the mist which rose so frequently from the river. When I picked up the negative, I found the batteries under water, but fortunately I was using a four-cell combination which had plenty of strength after being dried out, to shoot my fuses. I had left the camera and flash lamp standing when I took in the batteries and, upon my return at the end of the day, found both blown down and the sapling broken off by the wind. Moisture between the two elements of the front half of the lens prevented a hurried set in the dusk, so the camera was brought in and the sapling left re-stuck in the ground. Again that morning I had found all the small boughs eaten. The river broke through at its mouth in the forenoon and by evening had gone down nearly a foot. I was rather surprised to find a good many flies in evidence, although they were not really troublesome.

The continued north wind drove the temperature down so that by 7:45 on the morning of the twenty-first the thermometer registered about 38°F. During the night my sapling had been cut down and removed. I left the camera set on each of the three succeeding nights. Beaver came in on the first of these three nights and ate some bark off the bottom of the sapling and again cleaned up all the small boughs, but did not persevere long enough to give me a picture. During the following night the flash went off, caused apparently by the swaying or settling of the sapling. By this time the wind had become strong again, with more rain, and once more the river had risen six inches or so, loosening the sapling, thus permitting it to settle and probably discharge the flash as before. No sign that beaver had visited the spot during the last two nights could be found, possibly accounted for by the fact that on the twenty-first a load of poplar saplings had been put into the river five or six hundred yards above my poplar and that by the night of the twenty-second the beavers had found this splendid supply of their favorite food.

On the twenty-fourth I made my last trip to the set and took down the camera.

Earlier in the year, during August, I think, C. H. Hodges, Jr., had secured a very good isolated picture of a beaver travelling its runway. Here again the effect of mist was noticeable in the density of the negative.

Chicago, Illinois.

FIG. 1.

FIG. 2.

FIG. 1. CAMERA SET FOR BEAVER. NOTE PARTLY CUT POPLAR
FIG. 2. BEAVER ON RUNWAY IN MIST. AUGUST, 1925. PHOTO BY C. H. HODGES, JR.

FIG. 3.

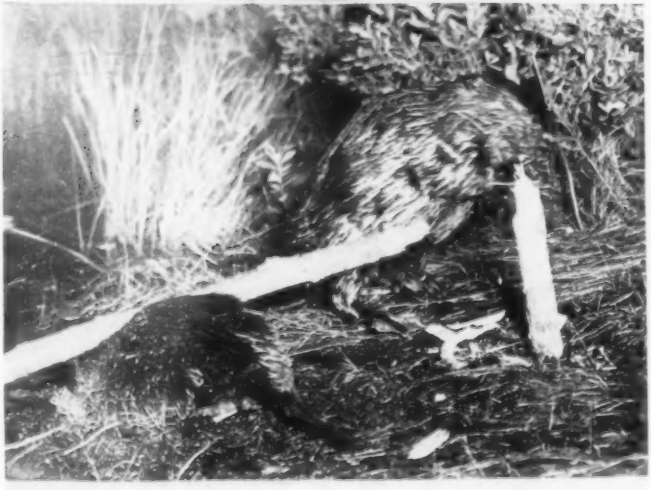

FIG. 4.

FIG. 3. BEAVER CUTTING POPLAR. SEPTEMBER 15, 1925
FIG. 4. FALLING POPLAR APPARENTLY STRIKING SMALL BEAVER. SEPTEMBER 17, 1925

UNIV. OF MICH.

HOW MAY OUR LARGE MAMMALS BE PROTECTED?

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Not only the zoologist, and nature lover, but every good citizen should be interested in this question: *How may our large mammals be protected?*

The purpose of protection is first of all, the perpetuation of the species. Genuine sentiments, too, have a right to exertion. Every nature lover rightly bemoans the rapid disappearance from this continent of the wonderful, large, native quadruped fauna. But the right kind of sentiment which loves life for life's sake is not easily cultivated. The protectionist and real nature lover look into the future. They live in the present, but they have a vista of their land many generations hence; they see in the present race an unintelligent crave for laying low and placing within the reach of the paw every organism the continued existence of which would far better further the interest of the race than its death. But the urge to kill everything that moves is so strong that it is very difficult to temper the mind to reason and retrospect; to view the past and present in the future.

The inclination to destroy life, which is possessed by beasts and many men, is the result of the condition of the mind. The wolf, in a flock of sheep, that kills all and eats only a heart or two, has an illusion. The carcasses are a less asset in his economic life than one dead and the rest living. The man, who kills a moose and carries home only a hind quarter, leaving the rest to rot, is a wolf! If the total kills are 95 per cent female moose, man's intelligence, represented by these killers, registers only 5 degrees if that much. The killing of 95 per cent of the females each season will exterminate the species in that part of the world very shortly, because it is the female that bears young. This important fact is recognized by many of our states which protect female deer. Although the large game, to a certain extent, belong to the nation and the future—as suggested by rules for the protection of game—the ownership, nevertheless, is too vague and indefinite. Whoever can carry a gun and brave the woods shoots whatever has breath!

Indeed, it is not only the large game which is threatened with extinction. In Illinois it is increasingly difficult to keep trespassers off the farmlands even though the owner lives nearby and the land is well posted. In the open season, the owners of a peaceful patch of untilled ground surrounded by his tilled fields is sometimes actually threatened with violence if strangers are not allowed to hunt on such a little re-

treat. The farmer's attempt to protect pheasant, quail, and other wild life on his own property is often impossible. Game which might be regarded his own are killed on his own land by strangers and carried away before his own eyes.

That a profound change of sentiment and viewpoint must come is necessary if the large game—and even the small game—of America shall not be exterminated forever! This is partly voiced by the pens of Hornaday, in Nature Magazine; by Gregg, in the Outlook; and by an anonymous writer in American Forestry. Hornaday writes about the deadly game-killing automobile; Gregg, about the fading game trails; and the unnamed Alaskan, on the moose butchers of Kenai. Lovers of wild life can not be too grateful for the inestimable good which is being done through the magazines I have mentioned and others, and which could be accomplished through the press. But the press is not doing enough at the present time to awaken a national sentiment for the protection of game.

The writer feels that a much more effective and enduring means for creating a lasting sentiment for good in this matter is by teaching the children the real truth and nature of this important American problem. Indeed, the adults of the nation today must be informed also, lest the children may find their knowledge inapplicable. Is it not strange, and yet a singular fact, that zoologists, particularly those who have had the inspiration to write text-books, are not aware of this important national problem? They have not manifested in their books their realization of this point. Consequently, too little is being done to create in the mind of the rising generation a sentiment for the protection and perpetuation of American native fauna. If the schools would do more about this, the parents would hear about it also.

When, in the winter of 1920–1921, I was teaching zoology in a university in a Rocky Mountain state, I was surprised to learn how thoroughly indifferent the people were about the American antelope, the home of which is in these mountains. Although this creature is nearly extinct, everyone seemed to think that it was still as common as the winds of the Plains of Laramie! None had any knowledge concerning the fast disappearance of this peculiar animal from its last foothold! Citizens frequently shot at it from automobiles. Even a good friend of mine, the Secretary of the University Y. M. C. A., boasted that he, while at his father's home in a neighboring state during Christmas, shot at a herd. He was not sure whether he hit any or not. A Swede, at whose house I lived, knew of places in town where heads of newly killed

antelopes could be found. Yet these people knew that the animal was protected. The only voice in the university town that spoke for the cause of this rare creature was a so-called radical newspaper. This paper advocated the apprehension of the lawless element which had been shooting at herds from automobiles. It was the practice, this paper said, first to wound a few, and afterwards accidentally find animals, sick and dying. For humane reasons, it was the duty of anyone to kill suffering, half-dead animals.

The American antelope (*Antilocapra americana*) is peculiar in several respects. It is an animal in which Americans should take special interest. Owing to its marked morphological peculiarities there has been erected for it a special family, Antilocapridae, of which it is the sole member. Its most outstanding peculiarities are: 1, it is the only living mammal with hollow horns which sheds them annually; 2, it is the only mammal with hollow horns which bear prongs or bifurcations; 3, it has no dew claws, as other ruminant animals have; 4, its horns are placed directly above the eyes; 5, the long hair of the body and neck is tubular; and, 6, the hair on the rump is erectable.

One eminent zoologist, Dr. W. T. Hornaday (1915), points out that the prong-horned antelope, unfortunately, is not such a hardy animal as the deer. Its kids are very difficult to rear; they are at all times easily hurt by accident, and even in a state of nature, this species suffers more severely in winter than any other North American ruminant. Often the little herds drift helplessly before the blizzards, with numerous deaths from freezing and starvation, and in spring the survivors come out thin and weak.

Nature, however, has provided a few means for the protection of this species. This has been pointed out by M. P. Skinner (1922) and E. W. Nelson (1925), who have observed this animal in its native haunts. They find that the adult is very alert; it can discriminate between native sounds and foreign sounds. The animal frequently bears twins which it hides among the rocks and glacial boulders of its native bench land. The young are placed in different hiding places and their color blends perfectly with the surroundings. The young will remain in hiding until they are practically stepped on; when they run, they start at once at full speed, and their speed is astonishingly great.

Fifty years ago the antelope inhabited the whole of the great pasture region which stretches eastward from the Rocky Mountains to the western border of Iowa and Missouri. Northward its range extended far into Manitoba; southward it went far beyond the Rio Grande, and

it also ranged southwestward through Colorado and Nevada to southern California. Its chosen home was the treeless plains, where the rich buffalo grass and bunch grass afforded abundant food, but it also frequented the beautiful mountain parks of Colorado and Wyoming. It even lived contentedly in the desert of the southwest, where its voluntary presence, coupled with the absence of water, constituted a problem which puzzled the brain of many a desert traveller. But at the present time there are only small herds in certain parts of the Rocky Mountain and adjacent territories. According to Doctor Nelson (1925), the total number of antelopes in Canada, United States and Mexico is about 30,326. Of these there are about 1,327 in Canada, 26,604 in the United States and 2,395 in Mexico, distributed over fourteen, two hundred and sixty-four, and eight areas, respectively. That is, the bulk of the antelopes today lives in areas within the United States. In the rest of the enormous territory previously mentioned the antelope has become extinct, and even the individuals now remaining are not safe. While a great deal is done by the U. S. Biological Survey to protect the antelope many trying difficulties are met with in this enterprise, notably the indifference of the people in certain antelope areas where the animals are killed just for the sake of killing. This coupled with the dangers from predatory beasts and the antelope's limited physical adaptability to artificial conditions threaten it with extinction. In point of fact, it is not only the antelope which is fast reaching this point, but other valuable game animals are threatened in the same way. This is the more serious since the introduction of the automobile in hunting has become a common practice.

Osborn and Anthony (1922) have shown very graphically, that on the whole, the mammalian fauna is on the wane; in fact, on a rapid decline towards extinction. They show how, during geologic time, one group of animals was superseded by another. That not until the close of the Age of Reptiles did the mammals have a very good chance. Climatic conditions subsequently played havoc with the existing mammal world, exterminating many superb races of mammals, and one or more of the inferior races of man. It is claimed that ever since mammalian perfection, 400,000 years ago, man has been waging his work of elimination. Man's demand for food, clothing, bone and ivory utensils, oils and fat, each in their turn, has played an important part in carrying to the point of extinction many valuable types! Other factors, such as those caused by agriculture, fencing, bounty system against carnivores, killing of game by ranchmen and cattle tenders,

and systematic poisoning, have been leading factors in practically wiping out game and other life in many parts of the United States. Fifty years ago, bison, mountain sheep, antelope, black-tailed deer, and elk were on the whole, common, and in some cases extremely abundant in the Rocky Mountain region. Now they are practically all gone!

These same authors continue:

> Nothing in the history of creation has paralleled the ravages of the fur and hide trade which, with the bone fertilizer trade, now threatens the entire vertebrate kingdom. The legitimate use of furs for protection in cold weather has long since passed. Furs are now a fashion, just as feathers were thirty years ago. Millions of dollars are spent annually in advertising. Furs are worn in midsummer purely for ornament and personal adornment, or to make a display of wealth and luxury.
>
> The final close of the Age of Mammals can be arrested only through the creation of sound sentiment and education of the children and women in the manner in which the National Association of the Audubon Societies has arrested the destruction of birds. (L.c., pp. 224–225.)

It is hardly pertinent, however, to include women to the exclusion of men in the educational process, because men are equally culpable in this respect. It is not women who are killing the *protected antelope*. Educate the children and both the men and women will be taught how to respect, protect, and allow the perpetuation of other mammals.

Bailey (1920) agrees that the state laws are inadequate for protection of the antelope, and the anonymous author from Alaska claims that the law is not adequate for the protection of the moose of Kenai. Osborn and Anthony think that the governor of Wyoming is doing all in his power to preserve the antelope of that state. Whatever may be the case, the fact remains that the settlers care very little for the governor's "distress" about the killing off of the game. It seems that as the Rocky Mountain states are becoming more and more settled, the prong-horned antelope must go before them. These settlers seem to be unable to live side by side with animals that do not belong to anybody in particular and not kill them. Is it then actually impossible to save the American antelope?

In spite of the timely warning made by certain naturalists, teachers of zoology and writers of text-books do not present the need for protection of the prong-horn to the youth of the land. It is evident that the American antelope is not tranquilly grazing on the plains of North America in herds up to hundreds, as seems to be the notion of some of the zoologists.

Education has been suggested. It should begin in the grade schools and be elaborated upon in the high schools so as to include most animals. It would seem that courses dealing with the general vertebrate fauna with emphasis on certain types that have positive and negative economic values, could be both attractive and useful to the students. Indeed, such a subject would by far surpass in usefulness from the aesthetic, economic, and cultural points of view, anything else taught in zoology in the schools of the entire nation. Unfortunately, biology in preparatory schools consists of a partial course in invertebrate zoology. Worse than that are the courses in general science. In fact, when the preparatory schools teach mostly invertebrate zoology to children, it goes to show that teachers do not know zoology. What is gained by teaching about totally unknown creatures to young students? Why not introduce the pupils to a few familiar forms with their striking characteristics: cats and dogs, sheep and oxen, goats and antelopes, horses and their allies, and man and apes? What child would not be interested in knowing about the difference in the paws of cats and dogs, the teeth of carnivores and herbivores, the faces, hands and feet of man and monkeys? Tremendous biological facts fundamental to modern thought in religion, philosophy and science are contained in these topics, just as in the principles of regeneration in hydra. But how far more intangible is not the biology of hydra, the earthworm and the crayfish to a child, as contrasted with the similarity between the face of a monkey and of a man! Too much modeling of a preparatory course on a college plan is indicative of insufficient knowledge of zoology. The point is, what may be suitable to teach college students may not at all fit the need of children of high school age. General science is a smatter of everything that leads nowhere except to confusion, because biology is more than a few butterflies. The consequence of our faulty teaching of biology in pre-college schools, in spite of our extensive educational system, is that the average adult is ignorant about animal life.

The fundamental cause for this ignorance in this vital realm of human existence is apparent. The university does not properly train high school teachers; superintendents and principals of secondary schools often employ as biology teachers individuals who have had only a course in general invertebrate zoology. Unfortunately, school boards do not realize the real educational value of zoology, and often request language teachers and mathematic teachers to fill-in with biology, even though these teachers have never studied biology before! The results

are self-explanatory. Any one can readily place the blame for a condition of this kind. It is not only the college professor's fault. It is true he is partly to blame because his text-book does not fill the real need, and he is not always willing to train high school teachers. He leaves the training too much to the department of education which teaches methods—*forever and ever*. Not how to teach biology, but how to teach everything, anything! It is not thought necessary to have *studied* a subject, but only to have studied *about* the subject.

Biology has, in addition to eugenics, medicine, sanitation, and agriculture, a good many other applications. One of these is civic duties as applied to the subject of learning how to leave harmless animals alone. For if man actually has intelligence higher than the "beasts" he should behave accordingly. The present writer thinks that a chapter on this subject might well be a part of any text-book in zoology. But it is not. (See: Packard (1886), Cockerell (1920), Dodge (1903), Hegner (1922), Newman (1924), and others.) It can not be expected that the biology teacher in high schools will do any better. When he models his course on some text, or on his college course in zoology, he is perhaps doing as much as his genius demands of him. Of course, this is proof that he does not know his subject very well. The world about him with its myriads of creatures means practically nothing to him. It is a chaos greater than that it represented to the ancients, because our time demands more than the time of yore. All the wonderful advancements in biology, the highly stimulating discoveries of which the present day can boast, are totally unknown subjects to a good many biology teachers. Even the large animals are not subjects of interest in anyway whatever. But why are our biologists not interested in this? European zoologists, thousands of miles away, have more to say about the American antelope than we have. They, at least, point out the wonderful nature of this form. (See: Beddard, 1902, pp. 306-307; Landois, 1905, p. 604; von Hanstein, 1907, p. 52; Shipley and MacBride, 1915, pp. 694, 697; Schmeil, 1916, p. 133; Boas, 1920, p. 670).

The students in the Rocky Mountain university, mentioned above, had not the slightest notion why the antelope is protected. When first approached on the matter, they stated that they thought it was a deer, "the fleetfooted one," which was protected all the year because it was a good runner. The cow-boy student claimed that it was "real sport to run them down in the fall; it is more fun than to round up the cattle!"

In the spring term of the year, vertebrate zoology was introduced to

a class in beginning zoology. It was a delight to bring in the story about the wonderful *Antilocapra*. The students in this course showed considerable interest in the work. Of course, like so many other students, they had very little background in biology and only a few fundamentals could be given in that brief time. However, every phase of the work, especially the avian and mammalian classes aroused a great deal of enthusiasm. On account of the newness of the subject, some practical problems were introduced. One of these was concerning the antelope. At first, it seemed difficult for them to understand why one animal was of any more importance zoologically than another. Little by little, however, it dawned on them, and the subject seemed worth while.

In the final examination, one of the questions asked was to characterize the antelope, to state reasons why it is protected, and to suggest how it may be protected more successfully. The answers given to this question indicated that the students had taken the matter seriously. Most of them gave the peculiar zoological features of this animal and stated how it should be better protected. The following is a typical answer, in part: "This animal is protected because it is pretty; it is harmless; and it is scarce, being found only in the Rocky Mountains. It should be protected more efficiently because of the scarcity of its number, because of the grace and charm it adds to our mountains, because of its interesting characteristics; because it is a native of Wyoming and some other western states, and because there is a law against shooting it, and laws should be enforced. This may be done by having reservations, by stricter enforcement of the laws, by getting game wardens that know what they are doing, and by teaching the children in school to respect these animals." From the above it may be reasonable to believe that the teaching was not in vain.

One may be pardoned for referring the reader to a country across the ocean. In certain parts of that commonwealth, the people were left free to do as they chose for a long time. The result was that all game were driven out of those parts, mostly, of course, exterminated. In the older settled parts, where large estates were controlled by single individuals, game found shelter. This game did not actually belong to anybody, but it was forbidden for any outsider to hunt on these estates, and the owner himself could not hunt except during the open season. In due time, public sentiment provided protection for all game in all parts of the country. At the present time, it is an unheard of thing for

anyone to kill game out of season, in that country. If a hart[1] or an elk[2] is seen in the woods during the inter-season, it is actually spoken of with certain pride. Kill one? Not at all! These animals are protected by law. The state wishes that they should not be killed off. They are left in peace. As a result, glorious and majestic animals, as the hart and elk, come to the edge of the forest at the outskirts of large cities, and may be seen strolling leisurely from one thicket to another. Indeed, in the outskirts of the city of Hamar, one day last winter (1924–25), a little girl came late to school because three large elks were standing in the road she had to pass. It is really considered an honor to have such visitors. At Hamar, the elk is injurious to the orchard; fences are no obstacle to him. But should one exterminate this wonderful creature because he can jump fences? (See: Schöyen, 1913.)

The people in the various sections of our country can also acquire a soul and spirit and the attitude toward large game as possessed by the people of Hamar, for, after all, is not life more than food? But, to gain this spirit means that a new attitude must be acquired. Probably this can be done best through the agency of education; the right kind of education will accomplish what a wrong kind can not. Doubtless the school-room is the logical place for the instruction in methods of conservation. May not man's instinct to kill be abated, now that he has no real need of it for protection, and has so many other pleasures and advantages besides?

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[1] Cervus elaphus.

[2] Alces machlis.

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EXTERNAL CHARACTERS IN THE STRUCTURE OF THE FEET AND THEIR VALUE FOR THE CLASSIFICATION OF THE VOLES

By Miss N. M. Dukelski

Several works on the classification of different species of Microtinae (voles or water rats) mention the pads on the hind feet, characteristic as to size and number, while some authors give minute descriptions of the feet and even make use of these characteristics to subdivide the genus *Microtus* Schrank into several subgenera. To justly appreciate these characters one must take into consideration variability, individual and due to age, as well as sexual and seasonal dimorphism. Ecological conditions ought likewise to be studied, as the structure of the feet presents adaptations to this or that mode of life.

The material for my researches was taken from the vast family of the Microtinae, rich in species of a wide range, living in different ecological conditions.

I am very glad to be able to present my deepest thanks to Prof. G. A. Kojevnikoff for kindly allowing me to study the collections belonging to the Zoological Museum of Moscow University, and to Prof. S. I. Ognev for his valuable suggestions and guidance during my work.

The principal object of my researches was to elucidate whether the morphological peculiarities of the feet can be considered as having a systematic value. To give an exhaustive answer to this question the variability of these characters had first to be examined, and only after such an investigation could the attempt be made to describe in detail the various species and subspecies of voles.

I will give a brief sketch of the position the pads occupy upon the fore and hind limbs. The entire family of Microtinae is conspicuous for the uniform structure of the fore foot. There are always five pads; three small ones situated at the base of the toes in a triangle, and two large ones, side by side, below the wrist. Such is the typical configuration of the pads in all the voles. On the hind foot the pads are five or six in number. Four of them are placed at the base of the toes, and according to the order in which they are placed, each of them can be named by a corresponding number. The place of the fifth or heel pad is about the middle of the sole; that of the sixth, which is always smaller than the rest, is between the fourth and the heel pad. Of the many morphological characters belonging to the feet, the number, disposition,

shape and size of the pads are those which have the greatest importance. Consequently the variability of these characters must be examined first.

Sexual dimorphism is lacking. Seasonal variations occur, but they are extremely insignificant and are apparent only in a large series.

Variability, due to age is rather pronounced, but, owing to insufficiency of material for investigation it could be traced only in six species of voles: *Evotomys glareolus* Sch., *Microtus arvalis* Pall., *Chilotus socialis* Pall., *Stenocranius major* Ogn., *Arvicola amphibius* L., and *Alexandromys pelliceus* Thomas. If in voles of different ages we compare the hind feet, we will observe the following variations, common to all the six species. In young individuals all the pads are rounded and nearly of an equal size; from earliest youth their disposition is typical for a given species. Further, the proportional relations between the length of the toes and that of the whole change and diminish exceedingly with age. Then too, it is only in the adult individual that bristles appear at the base of the claw.

Let us examine now the influence which the substratum has upon the structure of the feet by comparing, first several series of kindred forms, but whose mode of life is not the same, and then by drawing a comparison between representatives belonging to different groups of small rodents whose habitats are more or less the same.

The following series gives an exceedingly striking example of the passage of kindred forms from an arboreal to a terrestrial mode of existence: *Sciurus vulgaris, Tamias asiaticus* and *Citellus musicus.* If we compare the structure of the feet in the representatives of this series, it will be seen that there exists an analogy between these three forms as to the shape, number and disposition of the pads. The configuration of the pads on the fore foot is the same as in the voles; that of the hind foot is typical for the group considered and remains unaltered even under the influence of a totally different mode of life. The squirrel, the booroondook (*Tamias asiaticus*) and the souslik have four large oval pads at the beginning of the toes on the hind foot.

The change from an arboreal to a terrestrial mode of life manifests itself in a few characters only: structure of the toes, length of the claw-like nails, and more or less abundant fur on the sole.

The picture is entirely different if we compare the arboreal and terrestrial dormice. All the representatives of the former have feet of an analogous structure, sharply differing from those of the terrestrial genus *Myomimus*, which resembles a mouse in its external morphological characters and can only be numbered among the dormice owing to the

structure of its skull and teeth. What were the causes that have led to such a strong alteration of the external characters? It is difficult to say. It may be that ecological conditions played an important part here and that an adaptation to them only manifested itself in an alteration of the external characters. The description of the configuration of the feet, for example, of *Muscardinus avellanarius* L., as representative of the arboreal dormice, and of *Myomimus personatus* Ogn., as representing the terrestrial ones, will amply suffice to exhibit the points of difference of these two groups.

In *Muscardinus avellanarius* L. both fore and hind feet are adapted for climbing; the long toes, with strongly developed terminal pads, as well as a first toe, situated on the hind foot opposite to the others, favor this mode of locomotion. The disposition of the pads on the sole is very curious. The first pad, large and round, is at the base of the first toe. The next in order, four smaller oval pads, surround it at a little distance. The elongated heel pad is pushed far back, close to the inward edge of the sole. On the fore foot one can notice a strongly developed external hind pad.

The structure of the feet is quite different in *Myomimus personatus* Ogn., reminding one strongly of that of voles. Six minute pads are placed in three oblique rows at a certain distance from each other upon a broad slightly furry sole. The toes are rather short, with undeveloped terminal pads. At the base of the toes on the fore foot, three tiny pads form a triangle; there are two larger ones at the beginning of the wrist, just as in the voles. Thus in the present case one can not establish the kinship between *M. avellanarius* (L.) and *M. personatus* Ogn. upon the morphological characters of the feet, and it is to be expected that in other groups too there exists a convergence between the structures of the feet, which depends upon the nature of the substratum. To make it clear a comparison must be made between two series of representatives belonging to different systematic groups, but unified by having the same stations of habitat. Thus, for example, on the one hand the dwellers of the steppes, where the soil is hard and sometimes even stony, and on the other, the inhabitants of the forests and of such places where the soil is soft.

First series: *Sicista nordmanni*, *Mus musculus hortulanus*, *Chilotus socialis*.

Second series: *Apodemus agrarius*, *Microtus agrestis*, *Evotomys glareolus*.

The most attentive comparison of the two series does not allow us

to establish, in the structure of the feet, any general characteristic feature, either for the first or for the second series. Every representative keeps the peculiarities inherent to the systematic group to which it belongs.

After reviewing thus briefly the variability of different characters and their subordination to ecological conditions, I will now proceed to describe the different types of the subfamily Microtinae. There is no need to describe the fore feet, as it is only on the hind foot that the principal characters, such as the number of the pads, their shape, size and disposition, vary in the different genera of voles. The configuration of the pads on the fore foot is everywhere the same, and their size changes so little that no conclusions can be founded on these characters. Secondary characters, or rather more minute ones, such as the length of the claws, the stiff bristles at their bases, the furry sole, etc., are perfectly coördinated between the fore and hind feet, so that it is quite sufficient to mention them in describing the posterior extremity.

1. Arvicola amphibius L. (Gov. of Moscow.) There are five pads on the sole. The first four, situated at the base of the toes, are oval shaped and of a more or less equal size; the fifth or heel pad is shaped like a bean, twice as large as the others and lies apart by itself. The sole is slightly furry. There exists a small membrane between the toes.

The claws are strong and have no stiff bristles at their bases. On the soles of some water rats a small additional pad has been discovered, placed near the outer edge of the first pad. The presence of the additional pad is by no means constant, sometimes it exists only on one foot; and in a single specimen only was it found on both feet. Owing to the scant material at my disposal it was difficult to find the explanation of this fact. Very probably it is a monstrosity.

2. Microtus (*Alexandromys*) *pelliceus* Thom. (Primorsky Province.) The sole is slightly furry, there are a very few short bristles at the bases of the claws. The pads on the sole are five or six in number. The first and smallest pad, is round, the second and third are triangular, the fourth is large and round, equal to or a little larger than the preceding ones; the heel pad is egg-shaped, and the sixth is small and round. It is not always that there is a sixth pad. Out of the twenty-three specimens examined ninteen had five pads, two had six, and in two there were six on one foot and five on the other. The disposition of the pads is like that on the feet of water rats.

According to its systematic characters taken all together the subgenus *Alexandromys* occupies a place intermediate between the genera *Microtus* Schrank and *Arvicola* Lacépède, the first having six pads, the second, five. The varying number of the pads fully confirms this point of view. Of course, it is difficult to say whether the sixth pad is a character that is vanishing or one that is only appearing.

3. Evotomys glareolus Schr. (Gov. of Moscow.) Bank vole. The long narrow sole is slightly furry. The bristles at the base of the claw are twice as long as the latter. The six pads are placed in three oblique parallel lines; all the pads

are small and rounded except the heel pad, which is long and larger than the others.

4. Evotomys irkutensis Ogn. (Baikal.) The broad sole is thickly furred, the bristles one and one-half times longer than the claw. The pads are all large, triangular, and equal in size except the small scarcely noticeable sixth one.

5. Evotomys baikalensis Ogn. (Baikal.) The fur on the sole is scant. The pads are large and rounded, except the heel pad which is smaller than the other four, and the sixth one, situated close to the heel pad, which is not as usual on the edge of the sole, but nearer to the middle.

The genus *Evotomys* Schrank is fully determined by its systematic characters. It must therefore be opposed to the whole genus *Microtus* Schrank, and such sub-divisions as *Chilotus*, *Stenocranius*, etc., must also be considered as subgeneric entities. The descriptions of the three species of *Evotomys* show that the structure of the feet does not present here any such generic characters as could embrace the entire group, and that those existing can enable us only to differentiate distinct species. A comparison of the feet in the three species just mentioned shows at once that *Evotomys irkutensis* Ogn. and *Evotomys baikalensis* Ogn. resemble each other and differ from *Evotomys glareolus*. In other terms, a difference exists between the European and the east Siberian forms.

6. Microtus arvalis Pall. (Gov. of Moscow.) The six pads are placed in three oblique lines but owing to the nearness of the heel pad to the first and to the sixth, two triangular groups are constituted of three pads each. The second, third, and heel pads are elongated, the first and the sixth are rounded and smaller than the others, while the fourth, of triangular shape, is the largest. The sole and toes are thickly furred. The claws are weak and have stiff bristles at their bases.

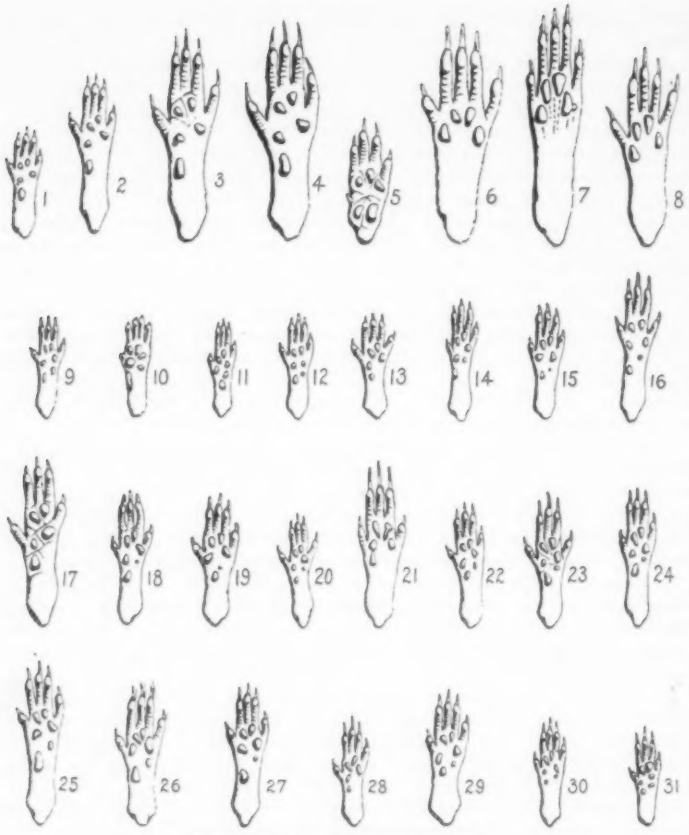
7. Microtus agrestis L. (Gov. of Smolensk.) Field vole. The sole is slightly furry, with a few scant bristles at the bases of the claws. The number and disposition of the pads are the same as in *Microtus arvalis* Pall. All the pads are elongated and equal in size with the exception of the sixth, which is much smaller than the rest.

8. Microtus oeconomus Pall. (Primorsky Province.) The broad sole is slightly furry, the bristles somewhat longer than the claws, which in this species are strongly developed. The six pads are placed in oblique parallel lines; the four first are rounded; the heel pad is ovoid-elongated, larger than the others; the sixth pad which is the smallest, is close to the fourth.

Microtus oeconomus Pall. and *Microtus ratticeps* Keys. and Blas., by the configuration of their pads, are much more like the east-Siberian representatives of the genus *Evotomys* than *Microtus arvalis* Pall and *Microtus agrestis* L. Therefore, on account of the morphological characters of the feet, the genus *Microtus* proper, like the genus *Evotomys*, falls into two distinct groups: the European group and the east Siberian one. To the latter one can also join *Chionomys nivalis gud* Sat. and *Platycranius strelzowi* Kastsch. There is no doubt that this resemblance between forms not allied to one another can only be due to the influence of ecological conditions, which have combined them in one group.

9. Microtus ratticeps Keys. et Blas. (Gov. of Moscow.) The sole is slightly furry, the few bristles are somewhat longer than the claw. The shape and disposition of the pads is excessively like that in *Microtus oeconomus* Pall.

10. Chilotus socialis Pall. (Gov. of Stavropol.) There are five pads upon a



FIGS. 1 TO 31. FEET OF RODENTS

1, 2, 3, 4, Arvicola amphibius (variability due to age); 5, Arvicola amphibius (fore foot); 6, Citellus musicus; 7, Tamias asiaticus; 8, Sciurus vulgaris; 9, Myomimus personatus; 10, Muscardinus avellanarius; 11, Sicista nordamanni; 12, Mus musculus hortulanus; 13, Chilotus socialis; 14, Evotomys glareolus; 15, Apodemus agrarius; 16, Mus sylvaticus; 17, Alexandromys pelliceus; 18, Evotomys irkutensis; 19, Evotomys baikalensis; 20, Microtus arvalis; 21, Microtus agrestis; 22, Prometheomys schaposchnikowi; 23, Microtus oeconomus; 24, Microtus ratticeps; 25, Chionomys nivalis gud; 26, Chionomys nivalis ighesicus; 27, Platycranius strelzowi; 28, Stenocranius slovzowi; 29, Stenocranius major; 30, Stenocranius gregalis; 31, Stenocranius eversmanni. All figures represent preparations conserved in alcohol and are natural size.

short, broad, very furry sole. The first four pads are equal in size, situated at the base of the toes. Below them is the isolated heel pad, always smaller than the rest.

11. Chionomys nivalis gud Sat. (Northern Caucasus.) The broad sole is abundantly covered with fur. The bristles, closely set, are one and one-half times longer than the claw. The grouping of the six pads is a very curious one. The first four, large, triangular in shape, lie at the base of the toe, forming an almost regular rectangle. The heel pad, which is the largest, is bell-shaped and occupies the middle of the sole, the small elongated sixth pad being situated between the heel pad and the fourth one.

12. Chionomys nivalis ighesicus Schidl. (Daghestan.) This subspecies differs from the preceding one in the closer grouping of the first four pads, the much greater size of the fifth pad, and its nearness to the sixth.

13. Platycranius strelzowi Kastsch. (Prov. of Semipalatinsk.) Differs from *Chionomys nivalis gud* Sat. in its less furry sole, and the shape and size of the pads, which are all rounded and of the same size, with the exception of the smaller sixth one.

14. Stenocranius slovzowi Pol. (Gov. of Perm.) The sole is very furry, the bristles one and one-half times longer, than the claw. The number of pads is not constant; out of eight specimens, there were five with six pads and three with five. All the pads are round; the first four are equal in size, the heel pad is much smaller than the rest, and situated very close to the sixth pad. This last is very small and lies beside the fourth pad. The pads are all placed in three oblique parallel lines, this being a feature common to all the representatives of the subgenus *Stenocranius*.

15. Stenocranius eversmanni Pol. The sole and toes are very furry, the bristles are somewhat longer than the claw. The first, fourth, sixth and heel pads are rounded and of equal size; the second and third are triangular, this last being much larger than the others.

16. Stenocranius gregalis Pall. (Transbaikal.) The broad sole is slightly furry; the toes are armed with strong claws. All the pads are small. The second, third and fourth are elongated; the first, sixth and the heel one are round, smaller than the others and placed closely to each other.

17. Stenocranius major Ogn. (Jamal Peninsula;[1] Siberia.) The very broad sole is furry to such an extent that in some specimens the hind pads are covered by the fur. The dense bristles are much longer than the claw. All the pads are large and triangular, except the small round sixth pad.

18. Prometheomys schaposchnikowi Sat. (Northern Caucasus.) The structure of the hind foot, as well as that of the fore foot of this interesting animal, is exceedingly unusual. On the fore foot the three first pads are reduced and do not form a regular triangle, but are placed in oblique line, while the two hind pads are strongly developed. On the hind foot, five pads are placed in straight parallel lines: the second and third elongated pads are placed at the base of the middle toes, the first and fourth rounded pads lie at the base of the first and fifth toe, and the elongated heel pad touches the first pad. The sole is but slightly furry, the

[1] Yalmal, Jalmal, or Samoyedes Peninsula on most maps. (*Editor.*)

West Transcaucasia. In Transcaspia this species is met with near Kushka and in the Kopet-Dagh Mountains. In Turkestan only one specimen was found, near Tashkent.

2. *Rhinolophus ferrum-equinum bocharicus* Kastsch. and Akimov (1917). Extensively found in Bucharia, Ferghana and Samarkand regions, and near Tashkent.

3. *Rhinolophus hipposideros hipposideros* Bechstein (1800). Gov. of Charkov (near Slavjansk), gov. of Tambov? (after Assmus); gov. of Kiev, Bessarabia, Crimea, Caucasus (Ciscaucasia and Transcaucasia), Turkestan (Samarkand district).

4. *Rhinolophus euryale euryale* Blasius (1853). This species is found in the districts around the middle part of the Arax River and in Ordubad. In the caves of Abchasia and Cebelda it has a peculiar dark colored form, *R. e. nordmanni* Satunin.

5. *Rhinolophus blasii* Peters (1866). The Arax Valley near Ordubad; Durun and Baharden caves near Curt-Su (Transcaspia).

KEY TO RUSSIAN SPECIES OF RHINOLOPHUS[2]

A. Second upper premolar borders directly upon the canine tooth, because the very small first premolar is moved outwards; sella, viewed from the side, forms two round projections, of which the upper is somewhat larger than the lower one.

a. Dimensions great; forearm, 56.3–61 mm.; total length of skull, 22–25.1.

a¹. Horse-shoe narrow, its width 7.7–8; length of tail, 31.5–34.....*R. f.-equ. proximus* Anderson*
(This species is described from Gilgit; it may possibly be found in the Pamir country.)

b¹. Horse-shoe wider, 8.5–9 mm.; length of tail, 32.5–43.
R.f.-equ. ferrum-equinum

*c*¹. Horse-shoe very large, 9–10.2 (M. 9.5); length of tail, 31–39.1.

a². Total length of skull, 25–25.1; forearm, 59.9–61.
Rhinolophus ferrum-equinum mikadoi subsp. nov.*
(The type from Yokohama; the paratype from Nagasaki. It is possible that this subspecies may be found near Vladivostok.[3])

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[2] The forms that have not been found in Russia but the discovery of which is possible, are marked in this list with an asterisk (*).

[3] A short description of this bat follows:

Type.—No. 4238, ♂; April, 1890; Yokohama; Dr. Isaev, collection of the Zoological Museum of Moscow University.

Diagnosis.—Size greater than *Rhinolophus f.-e. ferrum-equinum*. Total length of skull, 25–25.1 mm.; condylobasal length, 22.6–22.9; zygomatic width, 12.1–12.3; interorbital constriction, 3.2; greatest width of skull, 11–11.1; greatest height, 9.8–9.9; upper tooth row, 9 mm. Forearm, 59.9–61; tail, 37.6–39.1; breadth of sella, 9.8–10.2. Color bright with a tawny tint.

b². Total length of skull, 22.9–23.7; forearm, 57.2–59.3.....*R.f.-equ. nippon* Temm.* (Japan).

b. Dimensions medium; forearm, 49.9–52.6; total length of skull 19.9–20.5; breadth of horse-shoe, 6–6.5.....*R.f.-equ. bocharicus*

B. First upper premolar not large, but disposed in a row with the other teeth; it very conspicuously separates second premolar from canine. The sella, viewed from the side, forms one or two sharp projections.

c. Dimensions small; forearm 36.2–40.4; total length of skull, 15.2–16.2; sella viewed from the side forms an upper rounded blunt projection and a lower long and thin one, sharp at the point, inclining downwards and flattened below....*R. hipposideros*

d. Dimensions of medium size; forearm 44.6–51.4; total length of skull, 19–20.

d¹. Sella viewed from the side, forms sharp long upper projection, which is only slightly raised and inclined forwards; this projection is visibly longer than the lower one, which is rounded and flattened below.

c². Condylobasal length, 16.4–17.8; forearm, 45.4–49. Length of first phalange of fourth wing digit (IV^1) slightly greater than $\frac{1}{2}$ of IV^2 (the correlation between IV^1 and IV^2 = .38).[4] *R. euryale*

d³. Condylobasal length, 17.4–18; forearm, 48–51.4; IV^1 shorter (the correlations in the length of it and IV^2 are 44).....*R. mehelyi* Matschie* (Roumania, France, Spain, and Sardinia. It is possible that this species can be found in Bessarabia and the southwestern part of Russia.)

e¹. Sella forms an upper sharp projection which viewed from the side is hardly raised upwards; this projection is visibly larger than the lower one, which is short, round and flat below. Condylobasal length, 17.4–17.6; forearm, 44.6–47; length of IV^1 is greater than half of IV^2.....*R. blasii*

Systematical remarks.—From *Rhinolophus ferrum-equinum tragatus* Hodgs. this subspecies differs: 1, by its comparatively narrow zygomatic arches (in *R. f.-equ. tragatus* the width is 12.8–13.3 mm.); 2, by comparatively short upper tooth row (in *R. f.-equ. tragatus* the same is 9.3–9.9 mm.).

From *Rh. f.-equ. nippon* Temm. the new subspecies differs: 1, in larger skull; 2, in width of skull capsula; 3, longer forearm; and 4, broader horse-shoe.

[4] For brevity I mark the metacarpal bones of the wing by I, II, III, etc.; the Arabic numbers which are written above designate the number of the phalanx of the finger, as for instance, IV^1, IV^2, IV^3, etc.

FAMILY VESPERTILIONIDAE

The very large family Vespertilionidae includes in the Russian fauna three subfamilies, namely Vespertilioninae, Miniopterinae and Murininae, and contains eleven genera.

Subfam. Vespertilioninae

II. Genus MYOTIS

6. *Myotis myotis* Borkhausen (1797). Bessarabia, near Odessa, gov. of Kiev and of Charkov, Courland, Estonia, Livonia, in Crimea, Caucasus, Transcaspia, the Seven Rivers country (Semirechie, Turkestan).

The geographical distribution of this species is not sufficiently clear; all the preceding authors confuse it with the following form.

7. *Myotis oxygnathus* Monticelli (1885). I found a very great number of this species in the Crimea, Caucasus, (Ciscaucasia, Transcaucasia), Transcaspia (near Ashabad, the Kopet-Dagh Mountains), near Tashkent, in the Seven Rivers country.

8. *Myotis bechsteinii* Kuhl (1818). Courland, Estonia, Livonia; district of Eletz, gov. of Orel (after Danilov, 1868; this record should be confirmed). The district Olgopol, gov. Podolia (according to A. Brauner).

9. *Myotis nattereri nattereri* Kuhl (1818). Courland, Livonia, Estonia, gov. of St. Petersburg, the forest of Bialovesh, Poland, near Warsaw, the district of Kishenev (Bessarabia), Crimea, gov. of Orenbourg, Caucasus (Dagestan, gov. of Tiflis, and Kutaiss).

10. **Myotis nattereri amurensis** subsp. nov.

Type.—No. 1317, ♂, Amour River; cotype No. 4176, ♀, Vladivostok, Dr. Issev. Both specimens are in the collection of the Zoological Museum of Moscow University.

Diagnosis.—Resembling *M. nattereri* type, but differs: 1, in its shortened ear and tragus (length of the ear, 16.2–17.2; length of tragus, 9.7–9.8; in general in the typical form, 16.6–18.1; 10.2–13.3); 2, in the peculiarity of the ear extending slightly beyond the nostril when laid forward (as in *M. mystacinus*); in the typical form the ear, which is much longer and relatively narrower, extends conspicuously beyond nostril (about 5 mm.) when laid forward; 3, in its more convex skull in the frontal region, which is abruptly raised over the nasal part.

Systematical remarks.—It is interesting that the Amour subspecies differs widely from *M. nattereri bombinus*, which was described by O. Thomas from Japan (Tano, Miasaki, Kin-Siou, 32°).[5] In its subspecies, according to Thomas, the ear is much longer than in the typical race, and the tragus is turned more backwards; also, the skull is more flattened in the frontal region.

11. *Myotis emarginatus emarginatus* Geoffroy (1806). The Crimea (near Simpheropol, Salgir River), Transcaucasia (in the low districts along midstream of the Cura River). It is possible that the specimens from the latter locality belong to the following subspecies.

12. *Myotis emarginatus turkomanicus* Bobrinskoy. Near Ashabad, the Kopet-

[5] See: The Duke of Bedford's Zoological Exploration in Eastern Asia, Proc. Zool. Soc. London, 1905, p. 337.

Dagh Mountains, the districts Tedgen and Merv; valley of Mougrab River; in central Bucharia; Tsheleken Island (southern districts of the Caspian Sea.)

13. *Myotis mystacinus brandtii* Eversmann (1845). Governments of Moscow, Kaluga, Smolensk, Charkov, the region of the Don River, near Akkerman; governments of Symbirsk, Saratov, Orenburg, Ufa, Kazan, Perm, the center of Ural Mountains. Near St. Petersburg, gov. Archangel, the Baltic provinces, Caucasus, Transcaucasia, Transcaspia, Bucharia, Turkestan, gov. of Tomsk, Altai Mountains, the region of Semipalatinsk.

Systematical remarks.—This form is apparently larger than the typical race.

14. **Myotis mystacinus gracilis** subsp. nov.

Type.—Collected near Vladivostok, by N. P. Krilov; collection of S. I. Ognev.

Diagnosis.—Skull noticeably shorter than that of *M. m. brandtii*; total length, 12.2–13.4; interorbital constriction, 4.1; length of upper molar row, 5–5.3; forearm, 32.3–36 mm. Color dark, nearly as dark as in the so called "var. *nigricans*" Koch.

Systematical remarks.—In the structure of the small skull this subspecies resembles the typical form, but the exact difference from the typical form must be based on a greater number of specimens. The specimens from Turkestan and Transcaucasia are not identical with the described subspecies.

Geographical distribution.—East Siberia, Saghalien, Kamtchatka, the Amour region, as far west as Lake Baikal.

15. *Myotis ikonnikovi* Ognev (1911). The Ymanski district, Ussuri region.

16. **Myotis longicaudatus** sp. nov.

Type.—No. 4157; ♂; June, 1891. Vladivostok, Dr. Isaev; collection of the Zool. Mus., Univ. of Moscow.

Diagnosis.—Size small; total length of skull, 13.5 mm.; interorbital constriction, 4.7; length of upper tooth row, 5.2; forearm, 38.9.

The ear (length of each, 12.9) is very peculiar in general shape; it has a conspicuous emargination on the median part of the posterior border, and the extremity is narrow as compared with the broad proximal part. In comparison to the short ear, the tragus is very long, much more than half the height of the conch. The tragus sharply and unevenly narrows rapidly to the apex; in the middle part it is hardly narrower than at the base; its point does not turn backwards. The transverse palatal ridges are seven; it is interesting that the three first are not interrupted in their middle part; they are faintly bow-shaped forward; the three following ridges are interrupted in the middle and have a semi-bow-shaped form; the hindermost ridge is the shape of an obtuse angle.

The membrane is inserted at the base of the outer toe.

The second lower premolar is only one-third the length and two-fifths the width of the first. It is quite set aside in the inner part of the tooth row and not visible from outside. The second upper premolar is very short and completely removed in the inner part of the tooth row and it also is not visible from the outside.

The skull is unusually short and very concave in the occipital region. The frontal region rises abruptly above the nasal part, which is extraordinarily enlarged forwards.

The tail is very long (47 mm.; in *M. mystacinus brandtii* it is only 30–40 mm.). Its color is dark, almost as in the *M. mystacinus* form "*nigricans*."

Systematical remarks.—This species resembles *M. davidi* Peters from China, especially as regards the shape of the second upper premolar, but the tail of *M. davidi* is much shorter. According to Dobson the length of the body is 43 mm.; tail, 33; ear, 14; tragus, 7.5; forearm, 31.5; hind foot, 9.

17. *Myotis dasycneme dasycneme* Boie (1825). It is very possible that this species will be found in the Baltic provinces of the past Russian Empire.

18. *Myotis dasycneme major* Ognev (1924). Sporadically distributed in European Russia, in west Siberia, the Altai Mountains, Enissei region.

19. *Myotis daubentonii volgensis* Eversmann (1840). This subspecies is extensively spread over all European Russia and western Siberia.[6] It is possible that the typical *M. daubentonii daubentonii* Kuhl. inhabits the Baltic provinces and Poland.

20. **Myotis daubentonii ussuriensis** subsp. nov.

Type.—Collected near Vladivostok, by N. P. Krilov; collection of S. I. Ognev.

Diagnosis.—Size slightly less than that of *M. d. volgensis;* total length of skull, 14.2–14.7; condylobasal length, 13.2–14; zygomatic width, 8.9–9.3; length of upper tooth row, 5.1–5.6; forearm, 35–38.6; hind foot, 7.9–10. The terminal part of the ear is visibly narrower than in the typical race; the emargination on the hind (outer) ear border is more conspicuous; the tragus is sharply narrow at the tip. The ear, when laid forward extends about to the tip of muzzle. Color darker than that of *M. d. volgensis.*

Systematical remarks.—In a large series this subspecies is well marked.

Geographical distribution.—In eastern Siberia this subspecies inhabits the Amour and Ussuri region, Kamtchatka, Saghalien. Westward it is found in Transbaikalia as far as Irkutsk.

KEY TO RUSSIAN SPECIES OF MYOTIS

A. Size large; forearm, 53–64 mm.; total length of skull, 21–24; condylobasal length, 19–23.4; upper tooth row, 8.2–10.2.
  1. Membrane inserted at median part of side of metatarsus (sometimes nearer to the distal part of it).
    a. Size large; total length of skull, 22.5–24; condylobasal length, 21.5–23.4; zygomatic width, 14.1–15.8; upper tooth row, 9–10.2; forearm, 57.3–64....*M. myotis myotis*
    b. Size shorter; total length of skull, 21–21.9; condylobasal length, 19–21.1; zygomatic width, 13–14.4; upper tooth row, 9.2–9.4; forearm, 53–58.....*M. ozygnathus*

B. Size small or medium; forearm, 30–48; total length of skull, 12.7–18.1; condylobasal length, 12.2–17.3; upper tooth row, 5.1–6.8.
  2. Membrane inserted at proximal side of metatarsus.
    c. Size larger; condylobasal length, 16–17.3; zygomatic width, 10.8–12; upper tooth row, 6–6.8; forearm, 43.6–48. The hind (outer) ear border with conspicuous emargination; tragus half as high as conch; apex of tragus slightly contracted and bluntly rounded. (General shape of tragus like that of a sickle.) Palatal ridges eight.

[6] I believe that *M. petax* Hollister is identical with *M. d. volgensis.*

a¹. Size comparatively large; condylobasal length, 16.6–17.3; zygomatic width, 11.4–12; upper tooth row, 6.4–6.8; forearm, 45.1–48; hind foot, 10–12.6.....*M. dasycneme major*

b¹. Size shorter; condylobasal length, 16–16.8; zygomatic width, 10.8–11.2; upper tooth row, 6–6.4; forearm, 43.6–44; hind foot, 11.4. *M. dasycneme dasycneme**

d. Size shorter; condylobasal length, 14–14.8; zygomatic width, 9–9.8; upper tooth row, 5.4–6; forearm, 38.8–43. The hind (outer) ear border with a conspicuous emargination; tragus more than half as high as conch, apex of tragus sharply contracted and turned backwards. (General shape of tragus like that of a sabre). Palatal ridges seven.....*M. capaccinii* Bonap.* (Possibly this species inhabits Bessarabia and Crimea.)

3. Membrane inserted at first third of metatarsus (seldom in the middle of it).

e. Size short; condylobasal length, 13.2–14.5; zygomatic width, 8.2–9.8; upper tooth row, 5–5.7; forearm, 37–40. The back (outer) ear border usually has a slender emargination; tragus a little shorter than half the height of conch, and conspicuously narrow only in the terminal third; in middle outer border the width of tragus is approximately equal width at base; tip of tragus not turned backwards. Palatal ridges seven. P_2 is one-half as long as p_1, and one-half as thick in its basal diameter; c not longer than p_2.

c¹. Ear slightly narrow at the tip; emargination on its outer border slight; tragus slightly contracted at apex.

a². Size smaller; condylobasal length, 13.2–13.8; zygomatic width, 8.2–9; upper tooth row, 5–5.2; forearm, 37–38. *M. daubentonii daubentonii* Kuhl.*

b². Size greater; condylobasal length, 13.9–14.5; zygomatic width, 8.6–9.8; upper tooth row, 5.2–5.7; forearm, 35.6–40.....*M. daubentonii volgensis*

d¹. Ear narrower at the tip; emargination on its outer border deeper; tragus sharply contracted at apex.

c². Size smaller; condylobasal length, 13.2–14; zygomatic width, 8.9–9.3; upper tooth row, 5.1–5.6; forearm, 35–38.6. *M. daubentonii ussuriensis*

4. Membrane inserted at base of outer toe.
   f. Ear very long (21–25.6 mm.); it extends about 8 mm. beyond nostril when laid forwards; inner surface of conch with about 9 or 10 transverse ridges near posterior border. Forearm, 39–44.....*M. bechsteinii*
   g. Ear shorter (greatest length 18 mm.); it extends about 5 mm. (usually less) beyond nostril when laid forwards; inner surface of conch with 4 to 7 transverse ridges.
      e^1. Tragus very long, considerably longer than half the length of ear conch.
         d^2. Ear rather long (16.6–18 mm.); tragus proportionately narrow in its distal half; general form of tragus sabre-like; a slight emargination on the outer ear border; forearm, 36–40.6; length of tail less than length of body; free margin of the interfemoral membrane fringed with elastic hairs; p^2 one-half as long as p^1; transverse diameter of p^2 only one-fifth less than that of p^1; p^2 clearly visible in lateral profile of tooth row.
            a^3. Ear comparatively long (16–18 mm.); laid forwards, the ear extends about 5 mm. beyond nostril; tragus long (10.2–13.3); frontal region of skull slightly extended beyond nasal part..*M. nattereri nattereri*
            b^3. Ears a little shorter (16.2–17.2); ear extending scarcely beyond nostril when laid forwards; tragus comparatively short (9.7–9.8 mm.); frontal region slightly extended upon the nasal part.*M. nattereri amurensis*
         e^2. Ear relatively short (12.9 mm.); tragus sharply and unequally narrow towards the terminal part, its tip not turned backwards; outer margin of conch with very conspicuous emargination; forearm, 38.9; length of tail greater than that of body; free margin of interfemoral membrane not fringed; p^2 almost completely removed inwardly from the tooth row and not visible from the outside..*M. longicaudatus*
      f^1. Tragus moderately long, only half the length of ear conch.

f². Ear comparatively long (16.6–17.7); tragus proportionately narrow towards distal half, its general shape sabre-like; on the outer ear border is a very conspicuous angular emargination; forearm, 40–41; length of tail less than length of body; p^2 one-third as long as p^1, and one-sixth in transverse diameter; often p^2 is so removed in the inner tooth row that it is not visible from the outside.

e³. Tip of the tragus turned outwards; general shape of tragus sabre-like; free margin of membrane fringed with numerous soft hairs the length of which is 1 to 1.5 mm.; color, light pale yellowish with a brownish admixture; ears and wing membrane dull pale brownish.

M. emarginatus emarginatus

d³. The straight tragus tip is directed upright and not curved outwards; free margin of interfemoral membrane nearly devoid of hairs (where the hairs are visible they are very sparsely distributed); color lighter; pale yellowish, with a slight ochraceous shade; ears and wing membrane a dull pale sandy color.

M. emarginatus turkomanicus

g². Ears comparatively shorter (12.6–17; usually about 14.5); tragus proportionately narrow at its distal half; its tip more or less turned outwards; outer ear border with a slender emargination; forearm, 30–37.2; length of tail conspicuously less than length of body; p^2 a little shorter than p^1; transverse diameter of p^2 one-fourth less than in p^1; p^2 clearly visible in lateral profile of the tooth row.

e³. Ear comparatively long (13.5–17; usually about 14.5); conch conspicuously narrow in ter-

minal part; inner ear margin faintly convex; total length of skull, 14.3–15; condylobasal length, 13.9–14.3; upper tooth row, 5.6–5.9; forearm, 33.5–37. . *M. mystacinus brandtii*

f². Ear as in preceding form; but skull smaller in all dimensions; total length of skull, 13.3–14; condylobasal length, 12.2–13.4; upper tooth row, 5–5.3; forearm, 3.3–3.6. *M. mystacinus gracilis*

g². Ear short (12.6–13); not so narrow at the tip as in preceding forms; inner margin of ear more convex; total length of skull, 12.7; condylobasal length, 12.2; upper tooth row, 5.1; forearm, 30–31. *M. ikonnikovi*

III. Genus PIPISTRELLUS

21. *Pipistrellus kuhlii* Kuhl (1819). Crimea, Transcaucasia, Chiva.

22. *Pipistrellus nathusii* Keyserling and Blasius (1839). Widely spread over European Russia; north as far as Wiatka, south as far as Akkerman, gov. of Charkov, Woronesh, Astrachan. Not found in Crimea. In the Caucasus it was caught in the Kura Valley and in the Djevad district of the gov. of Baku.

23. *Pipistrellus pipistrellus* Schreber (1775). Extensively distributed over the south of European Russia. It is doubtful whether it lives farther north than the southern districts of the government of Smolensk. The flitter-mause is very common in the Caucasus (Ciscaucasia and Transcaucasia) and in Crimea.

24. *Pipistrellus pipistrellus bactrianus*[7] Satunin (1905). The most common bat of Turkestan and Transcaspia.

KEY TO RUSSIAN SPECIES OF PIPISTRELLUS

a. Outer unicuspid upper incisor shorter than half the height of the inner one, which has only a single cusp (without an additional outer cusp); transverse diameter of outer incisor approximately equal to half the inner one; second (great) upper premolar is approximate to the canine, first premolar being deeply moved to the inner of the tooth row and not

[7] I keep to this name, because Satunin gives the exact type locality. O. Thomas (Ann. and Mag., Nat. Hist., 1909, p. 58) affirms that the correct name of this bat must be *P. p. lacteus* Temm., but in the Monographie de Mammalogie (1838) Temminck brings forward a very questionable consideration, namely, that the type species of *Vespertilio lacteus* came from South America.

visible from the side (or scarcely visible), lower canine approximately three times as long as neighboring premolars; great digit of the wing moderately long (not less than 5 mm.); border of wing membrane (from the foot to the fifth fore finger) whitish; forearm, 34–36; palatal ridges eight.....*P. kuhlii*

b. Outer unicuspid upper incisor more than half the height of the inner one, which has two cusps; transverse diameter of outer incisor approximately 1½ times that of the inner one; second (large) upper premolar far removed from the canine; first premolar not moved to inner of tooth row and quite visible from the side; lower canine long and slender, and three times as long as the neighboring premolar; main digit of the wing long (not less than 5.2 mm.); border of the wing membrane (from foot to the fifth fore finger) uniformly dark (not whitish); forearm, 33–36; palatal ridges seven.....*P. nathusii*

c. Outer unicuspid upper incisor half as high as inner bicuspid; second accessory cusp of the inner incisor commonly higher than the outer unicuspid; transverse diameter of outer incisor approximately equal diameter of inner one (or slightly less); first upper premolar not moved to inner of tooth row and clearly visible from the side; lower canine approximately twice as long as neighboring premolar; main digit of the wing short (not longer than 5 mm.); forearm, 28.2–32.5; palatal ridges seven.

a¹. Color of back almost dark brownish often with a castaneous tint (some specimens have a palish admixture) in general tone; lighter below, with a pale tint; ears and wing membrane grayish brown; border of wing membrane uniform color, dark without whitish edge.....*P. pipistrellus pipistrellus*

b¹. Color of back visibly lighter, a pale brownish gray; below whitish; ear and wing membrane pale brownish gray; border of wing membrane with narrow whitish edge.*P. pipistrellus bactrianus*

IV. Genus NYCTALUS

25. *Nyctalus noctula noctula* Schreber (1775). Probably inhabits Poland and the Baltic provinces.

26. *Nyctalus noctula princeps* Ognev (1924). Widely distributed in all European Russia from Finland to the Crimea and Caucasus. It also inhabits western Siberia, Turkestan and the Seven Mountains country.

27. *Nyctalus siculus* Palumbo (1868). The districts of Charkov, Koupjansk, and Smiev in the gov. of Charkov; districts of Woronesh and Bobrov in the gov. of Woronesh; district of Busuluk in the gov. of Samara, Bessarabia, the Tauric gov., regions of Kuban and Terek.

28. *Nyctalus leisleri* Kuhl (1819). Gov. of Moskow, Smolensk, Toula, Yaroslav, Pensa, Saratov, Astrachan, Charkov, Woronesh, Kiev, Crimea, and the Baltic states.

KEY TO RUSSIAN SPECIES OF NYCTALUS

A. Condylobasal length more than 17 mm.; forearm more than 47 mm.; back hairs without dark roots (almost unicolored), straight but not wiry.

a. Condylobasal length more than 21 mm.; forearm greater than 60 mm.

a¹. Size large; condylobasal length, 22.2–22.9; zygomatic width, 15.4–16.1; upper tooth row, 9.1; forearm, 65.5–69; length of head and body, 88–106.4 mm.....*N. siculus*

b¹. Size somewhat smaller: condylobasal length, 21.2; zygomatic width, 14.9; upper tooth row, 8.5–8.7; forearm, 60.5–62; length of head and body, 85 mm.

N. aviator Thomas*

(Japan, Corea; probably this species can be found in the Ussuri region.)

b. Condylobasal length less than 21 mm.; forearm less than 60 mm.

c¹. Size comparatively large; condylobasal length, 19.1–20.1; zygomatic width, 13-14.5; upper tooth row, 7.4–8–3; forearm, 52–58; length of head and body, 70.0–85.

N. noctula princeps

d¹. Size slightly smaller; condylobasal length, 17.4–19.4; zygomatic width, 12.4–13.8; upper tooth row, 6.8–7.4; forearm, 51–54; length of head and body, 69–79

N. noctula noctula

B. Condylobasal length less than 17 mm.; forearm less than 47 mm.; back hairs bicolored, variable, with dark bases.

c. Condylobasal length, 15.2–16; zygomatic width, 10.1–11; upper tooth row, 5.8–6.3; forearm, 42.6–46.8; length of head and body, 53–62.....*N. leisleri*

V. Genus EPTESICUS

29. *Eptesicus serotinus serotinus* Schreber (1775). Southern part of European Russia from the gov. of Kiev, Charkov, Ekaterinoslav, and Orenberg. Very abundant in Crimea, Ciscaucasia and Transcaucasia.

29a. **Eptesicus serotinus intermedius** subsp. nov.

In the region of Terek (near Vladikavkaz, Murtasovo station), and probably in all the Kislar division where this form occurs, it does not differ in color from the typical *serotinus*, but has a markedly smaller skull and tooth row. This bat is an intermediate type between the *E. s. serotinus* and the following subspecies, *E. s. turcomanus*.

Diagnosis.—Skull shorter than that of the *E. s. serotinus*; total length of skull, 18.9–19.9; zygomatic width, 13.3–14; interorbital constriction, 4.3–5; upper tooth row, 7.1–7.3. Color as in the typical race.

Type.—No. 169, ♂, collected March 16, 1923, near Vladikavkaz, region of the Terek; collection of S. I. Ognev. A total of seventeen specimens were examined.

30. *Eptesicus serotinus turcomanus* Eversmann (1849). Gov. of Astrachan, Ust-Urt, Transcaspia, Turkestan, Bucharia.

31. *Eptesicus sodalis ognevi* Bobrinskoy (1918). Bucharia, Transkaspia (Aschabad), Seven Mountains region.

KEY TO RUSSIAN SPECIES OF EPTESICUS

A. Forearm less than 47 mm.; condylobasal length less than 18 mm.; upper tooth row less than 7 mm.; condylobasal length, 16.5–17.1; zygomatic width, 11–11.8; upper tooth row, 6.4–6.7; forearm, 45–46.6; color very pale, the back sandy gray sometimes with a chestnut tint; below white

E. sodalis ognevi

B. Forearm more than 47 mm.; condylobasal length more than 18 mm.; upper tooth row more than 7 mm.

a. The general color of the back varies from Prout's brown to clove brown; lighter below; naked parts (ear, nose, and membrane) blackish; condylobasal length, 19–21.6 mm.; zygomatic width, 14–15.4; forearm, 51.1–54.8; upper tooth row, 7.4–8

E. serotinus serotinus

b. Color much lighter; back a pale sandy gray; below white or with a delicate pale tint; ear and membrane light sandy grayish; condylobasal length, 18.1–20; zygomatic width, 12.1–13.9; forearm, 47–54.2; length of upper tooth row, 7.2–8

E. serotinus turcomanus

VI. Genus AMBLYOTUS

32. *Amblyotus nilssonii* Keyserling and Blasius (1839). Very common in the northern part of European Russia (Gov. St. Petersburg, Olonetz, Novgorod), northward as far as Ostfinmarken (70°) and in Russian Lapland to 60°; also in the western part of European Russia (Baltic states, Smolensk, near Ljublin). Not found in the central and southern governments. Occurs in the eastern part of European Russia: gov. Samara (near Samarskaja Luka), provinces along the lower part of the Volga River, gov. of Orenburg, southern foothills of Ural (as far north as 60°). It is very remarkable that *A. nilssonii* is found near Tiflis and in the district of Lenkoran. In western Siberia it occurs in gov. of Tobolsk, Tomsk, Altai Mountains, Tarbagatai; in eastern Siberia in the Apple Mountains, Stanovoy Mountains, and Amour region.

33. *Amblyotus caucasicus* Satunin (1901). Specimens have been found at different times in the winter season (November to April) near Tiflis. Probably *caucasicus* is a mountain species which descends in winter to lower places.

34. **Amblyotus tauricus** sp. nov.

Type.—From near the Biological Station of Karadagh, Crimea; collection of S. I. Ognev.

Diagnosis.—Size very small, about that of *Pipistrellus pipistrellus*; total length of skull, 12.7; interorbital constriction, 3.3; upper tooth row, 4.5; length of body, 41.5; tail, 9.3; forearm, 9.8; hind foot, 5.5 mm.

Ear conspicuously shorter than in *A. tamerlani*, its length 10.1 mm.; more rounded apically and not so narrow as in *A. tamerlani*.

Outer upper unicuspid incisor approximately two-thirds as high as inner one; transverse diameter of these teeth subequal.

Palatal ridges seven; membrane inserted at base of outer toe; first metacarpal bone of third digit subequal to that of fifth; wings comparatively narrow; the two terminal vertebrae of tail free from membrane.

Epibleme very thin and weak; hairs on the back bicolored, the bases brownish black, and the tips broadly whitish with a pale admixture; below the base of hairs are grayish black, the tips white; ears and lips dark brownish, almost black; wing membrane paler, and near the body it is covered with hair.

Systematical remarks.—This species is very near *A. tamerlani*, and possibly only a subspecies. *A. tauricus* differs from *A. tamerlani:* 1, in its less dimensions, 2, in shorter rounded ears, and 3, in lighter color.

Geographical distribution.—Only one specimen of this remarkable bat was obtained and that by Mr. Wuchetich, May 15, 1912, near the Biological Station of Karadagh (Crimea).

35. *Amblyotus tamerlani* Bobrinskoy (1918). Principality (the bey) of Baisun (Bucharia), Russian Mountains (east Turkestan).

36. **Amblyotus velox** sp. nov.

Type.—From near Vladivostok; collection of S. I. Ognev.

Diagnosis.—Size small; total length of skull, 13.3; condylobasal length, 13.1; zygomatic width, 8.3; interorbital constriction, 4; upper tooth row, 4.8; forearm, 35; hind foot, 7.4.

Ear of medium length (13.9), broadly rounded on upper part; inner border of conch not bow-shaped, but convex as in *A. nilssoni;* greatest width of tragus approximately in middle part; no additional lobe on outer margin of tragus, as in *A. tamerlani*.

Skull short, resembling that of *A. tamerlani*.

Outer upper unicuspid incisor is a third lower than the inner bicuspid and almost equal to the outer cusp of this tooth; in transverse diameter outer incisor approximately equal the inner one; last upper molar (m^3) weakly compressed in the sagittal direction, its frontal diameter being 1½ times greater than the sagittal.

Palatal ridges seven; free margin of wing membrane inserted at base of outer toe; third metacarpal equal to fifth; wings comparatively narrow; only one terminal vertebra free from membrane; epibleme well formed; color above dark brownish black with a pale golden tint on tips of hairs; below, tips of hairs pale grayish; ears, lips, wing membrane brownish black. Externally this bat is like the dark colored *Vespertilio murinus*.

KEY TO RUSSIAN SPECIES OF AMBLYOTUS

A. Forearm, 40–41.3; total length of skull, 14.9–16.1; condylobasal length, 14.1–15.6; zygomatic width, 8.9–10.6; greatest width of tragus is in its middle part, epibleme very narrow; bases of back hairs dark brownish, the tips light pale-golden; below, bases of hairs dark brown, the tips pale yellowish.....*A. nilssonii*

B. Forearm shorter than 36 mm.; total length of skull, 13.3–13.7; condylobasal length, 12.4–13.1; zygomatic width, 8.3–8.9.

a. Tragus with only one little rounded lobe at base of outer part; greatest width of tragus in middle; epibleme moderately well developed; only one terminal tail vertebra free; color dark brownish black with a pale-golden tint on back and a pale-grayish on underparts; naked cutaneous parts dark brownish black.....*A. velox*

b. Tragus with two cutaneous lobes on outer side, one of them near base of tragus greater than other, which is short and rounded in middle of outer border of tragus; greatest width of tragus in middle part; epibleme weakly developed and narrow; two terminal tail vertebrae are free.

a¹. Tragus slightly convex at its outer border; length of ear, 12.9–13 mm.; base of hairs on back blackish brown, the wide light tips pale yellowish; below, bases of hairs grayish black, tips whitish with a palish admixture; ears and lips brownish black; wing membrane slightly lighter.....*A. tamerlani*

b¹. Tragus dark, convex on its outer border; length of ear, 9 mm.; fur on the back dark brown with a yellow, as though golden, tint; below, grayish brown with a steel sheen; hairs bicolor; base of hairs brownish black, the tips on the back yellowish brown, on the underparts grayish; wing membrane and ears dark brownish-black.....*A. caucasicus*

VII. Genus VESPERTILIO

37. *Vespertilio murinus murinus* Linnaeus (1758). This bat is very widely distributed and is very common in all European Russia (from Finland to Crimea and Caucasia), and in Siberia to the Amour Gulf, Vladivostok and Corea; Turkestan, Transcaspia, Bucharia, and Seven Mountains country.

VIII. Genus OTONYCTERIS

38. *Otonycteris hemprichii* Peters (1859).

This bat ranges in the southern part of Transcaspia and middle Bucharia. In the collection of the Zoological Museum of Moscow University is the type-specimen (No. 1156) of *Plecotus leucophaeus* Severtzov, obtained near Djan-Bulak at the southern foot of the Kuraminsk Mountains, between Tashkent and Chodgent. This specimen was first described as a new species, but later referred to as *Plecotus auritus* var. *brevimana*. This specimen was attributed to this form by A. A. Tichomirov and A. N. Kortshagin,[8] although it is a typical *Otonycteris hemprichii*.

IX. Genus BARBASTELLA

39. *Barbastella barbastellus* Schreber (1774). Baltic provinces, gov. of Grodno (the forest of Bjalovesh), Poland, Crimea, Caucasus.

40. *Barbastella caspica* Satunin (1908). (*Synotus dargelingensis* after Dobson and Blanford, not after Hodgson; *Barbastella blanfordi* Bianchi; *Barbastella walteri* Bianchi.) Eastern Transcaucasia, Transcaspia, Turkestan.

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[8] See Izviestiia Imperat. Obshchestva Liubitelei estestvoznaniia, vol. 58, no. 4, p. 11, 1889.

KEY TO RUSSIAN SPECIES OF BARBASTELLA

a. No supplementary lobe on outer border of ear; ear when laid forwards extends 2 to 2½ mm. beyond nostril; terminal vertebra free from membrane; forearm, 40.6–44.5; total length of skull, 15.2.....*B. caspica*

b. A short rounded supplementary lobe on outer border of ear; ear rather short, reaching when laid forwards about tip of muzzle; only the tip of terminal vertebra free from membrane; forearm, 36–39.3; total length of skull, 14.2.....*B. barbastellus*

X. Genus PLECOTUS

41. *Plecotus auritus auritus* Linnaeus (1758). Distributed extensively in European Russia from Finland and the gov. of Olonetz to Crimea and the Caucasus. It inhabits western Siberia, the Altai and Tarbagatai Mountains, and also the region of Semipalatinsk. Probably the typical race ranges east as far as Lake Baikal.

42. *Plecotus auritus wardi* Thomas (1911). The Seven Mountains country (Semiretchie); the mountainous parts of the Bucharia; probably widely distributed in Turkestan.

43. *Plecotus auritus sacrimontis* Allen (1908). Saghalien Island, the Ussuri and Amour regions, Transbaikalia.

KEY TO RUSSIAN SPECIES OF PLECOTUS

A. Bullae very large and convex; length of bullae, 4.6–5 mm.; total length of skull, 16.9–17.8; condylobasal length, 15.8–16.6; forearm, 40.3–45.5; color very light pale-grayish above, whitish below.....*P. auritus wardi*

B. Bullae conspicuously shorter and not so convex; length of bullae, 4–4.5 mm.

a. Total length of skull, males (in females the skull is greater[3]), 17–17.5; condylobasal length, 15.8–16; zygomatic breadth, 8.5–9.1; length of upper tooth row, 5.7–5.9; color darker, more grayish and brownish.....*P. a. sacrimontis*

b. Total length of skull, males, 15.8–16.9 (females, 16.3–17.6); condylobasal length, males, 14.7–15.3 (females, 15–16); zygomatic width, males, 8.6–9.1 (females, 8.8–9.3); upper tooth row, males, 5.4–5.8 (females, 5.6–5.9); color as in preceding form *P. a. auritus*

Subfam. Miniopterinae

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[3] It is very interesting that in the genus *Plecotus* there is a remarkable sexual dimorphism; skulls of the females are greater than of the males. It is a pity that all five specimens of *P. a. sacrimontis* in my collection are females, their skulls are greater than those of males of *P. auritus auritus* and approximately equal to the skulls of females of this subspecies.

XI. Genus MINIOPTERUS

44. *Miniopterus schreibersii schreibersii* Kuhl (1819). Crimea and the Caucasus along the coast of the Black Sea.

45. *Miniopterus schreibersii pallidus* Thomas (1907). The districts along the median part of the Arax River, Transcaucasia and Transcaspia.

KEY TO RUSSIAN SPECIES OF MINIOPTERUS

A. Fur above moderately dark brownish gray; pale grayish below
M. s. schreibersii

B. Fur above pale grayish with a light brownish tint; whitish below
M. s. pallidus

Subfam. Murininae

XII. Genus MURINA

46. *Murina ognevi* Bianchi (1916). Near Vladivostok.

47. *Murina leucogaster sibirica* Kastsch. (1905). Kusnetzki Alatau.

48. *Murina ussuriensis* Ognev (1913). Ussuri region.[10]

KEY TO RUSSIAN SPECIES OF MURINA

A. Size short; forearm, 31–32 mm.; wing membrane fastened to distal part of outer digit, sometimes to tip of it near claw; first upper incisor slightly greater than second. General color of back pale grayish; below whitish; palatal ridges nine; parietal region considerably convex; occipital region comparatively abruptly flattened.....*M. ussuriensis*

B. Size greater; forearm, 40–42.3; wing membrane fastened to basal third of outer digit; first upper incisor equal to second.

a. Tragus perfectly straight, not turned outwards; only one lobe on basal part of tragus; back fur very bright golden yellowish with a palish tint; nape with a russet collar; palatal ridges 8....*M. ognevi*

b. Tragus slightly turned outwards at tip; two lobes on the basal part of tragus; general color of back brown, roots of hairs grayish
M. leucogaster sibirica

FAMILY MOLOSSIDAE

XIII. Genus NYCTINOMUS

49. *Nyctinomus insignis* Blyth (1863). Eastern part of Siberia (Vladivostok, Corea).

In Satunin's "Conspectus Mammalium Imperii Rossici" (1914, p. 44) is a doubtful indication that a bat of the genus *Nyctinomus* inhabits the southern coast of Crimea. Surely this can be only *N. teniotis* Rafinesque, a species of the Mediterranean subregion.

Zoological Museum, Moscow University, Moscow, Russia.

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[10] Recently A. de C. Sowerby described a new subspecies, *Murina huttoni fuscus*, from Girin, Manchuria (Journ. Mammalogy, vol. 3, no. 1, pp. 46–47, 1922). This bat probably will be found in the Ussuri region

GENERAL NOTES

THE RANGE OF CHIRODERMA ISTHMICUM MILLER

This grayish-brown species was first described in 1912 from two specimens obtained at Cabima, Panama, and Goldman in his Mammals of Panama, 1920, lists two others, one from Cana and one from Culebra. There are apparently no further examples known, so that it is worth placing on record the capture of an adult female at Presidio, Vera Cruz, Mexico, April 30, 1925. This considerably extends the known range of the species northward. The specimen was collected by Wilmot W. Brown and has been presented to the Museum of Comparative Zoölogy by Col. John E. Thayer. The receipt of this skin has made possible the identification of another without skull, in the museum, received from the Bangs collection some years ago. It was taken at Tenorio, Costa Rica, February 11, 1908, by C. F. Underwood, and though slightly smaller than the Mexican specimen, seems essentially the same.—GLOVER M. ALLEN, *Museum of Comparative Zoölogy, Cambridge, Massachusetts.*

LEAST WEASEL IN NORTH DAKOTA

In Professor Swenk's article on least weasels in a recent issue of the JOURNAL OF MAMMALOGY (November, 1926) no mention is made of the occurrence of *Mustela rixosa* in North Dakota, and in a further search through literature available to me discloses no record of this species from that state.[1] Of the three specimens of *Mustela rixosa* in my collection, two are from North Dakota and it would seem that these are worth recording at this time. The first specimen, a male, was collected at Grafton, March 14, 1923, by H. V. Williams, and the measurements as noted on the label are: total length, 188 mm., tail, 38, hind foot, 22. The second, also from Grafton, is a female taken December 31, 1923, measurements: total length, 170; tail, 34; hind foot, 21; the collector's name does not appear on the label. Both specimens are in white winter pelage with a few blackish hairs at the tip of the tail. The third specimen of this weasel in my collection is a male in summer pelage, with the tip of the tail missing, and is labeled: Calgary, Alberta; September 28, 1908; measurements, in inches: total length, 6¼; tail, 1½; hind foot, ¾. The above specimens are all skins with skulls.—ALEX. WALKER, *Tillamook, Oregon.*

MOUNTAIN LION EATS ITS KITTENS

In February, 1925, a hunter was detailed to the Wetmore district of the San Isabel National forest about thirty miles west of Pueblo, Colorado, to work on mountain-lion infestation reported by forest officials and stockmen. While hunting on the morning of February 10, the hunter succeeded in killing the first

[1] Since this note was written, records of the least weasel in North Dakota have been published by Vernon Bailey (A Biological Survey of North Dakota, North Amer. Fauna, no. 49, pp. 170–171, January 8, 1927). The specimens reported as actually examined are three, with localities and dates of collection as follow: Grafton, October 24, 1913; Fort Totten, July 21, 1913; and Bowdon, July 27, 1918.—*Editor.*

lion in this section. It was a female, had indications that it was nursing young, and from additional mountain-lion signs noted in the region, the hunter believed there was also a male lion and possibly several young ranging in the immediate vicinity.

The following day, the eleventh, the hunter returned to the place where he had killed the female, but did not find any fresh tracks or signs. Then on the twelfth he went six miles north of this point; it was on this day that a stockman of this region while riding for cattle tracked a lion which traveled in close proximity to where the hunter had killed the female on the tenth. At this time there was a beautiful tracking snow on the ground. Word of finding this fresh lion sign, however, did not reach the hunter until later. When he did get word, he immediately returned, and while hunting around this territory, which was where the female had been killed, the hunter's dogs found what evidently had been the den of the female. In the den the hunter found the remnants of two lion kittens, parts of which had been devoured, and which resembled in shape a pair of stockings that had been tied in a series of knots. From all indications and signs there was no doubt but that the lion that had been tracked by the stockmen on February 12 had returned to this den and killed the kittens. The tracks of this lion would lead one to believe that the animal was a male. I later made a personal investigation of the territory and satisfied my own mind that this lion carried out the trait, so common to the ordinary house tom-cat, of eating up the young when the female is not around to guard them.

The hunter continued his effort to capture this lion. On March 11 he succeeded in getting a run for it with his dogs. From all indications the dogs bayed the lion on a large boulder in a small open park, before the hunter could get to them. A battle royal took place and resulted in the lead dog being killed and the lion making its escape. The hunter used all the hunting sense which his experience had taught him. He was fairly certain that some of the signs that he had found were made by the female that he had killed on February 10. Other signs were found later that were made by the male lion that killed the dog on March 11. The fresh tracks plainly gave indication that this other lion was looking for its mate and had on several occasions visited the old den where the young had been killed and devoured. The hunter set traps close to these tracks, and used on each lion scratching close to the den a judicious amount of catnip scent. Two of these scratchings were on the eastern pine-covered slope a short distance above the old den. The hunter dropped two small logs on each side of these scratches parallel with each other and about two and one-half feet apart. On the upper side of each scratch he placed two traps, carefully concealing them level with the ground and covering them with pine needles. On top of the scratch marks an abundant supply of catnip oil diluted with petrolatum was poured. The arrangement of these logs left two ways that the lion might enter to sniff the scratchings and it was ten days later (March 21) that the hunter trapped the male.

Summing up: At the time the hunter reached the territory in February the male and female were together and had young in the den. The young were not quite a month old at the time the female was killed on February 10. Lion tracks and lion signs found after the killing of the female proved conclusively that she had a mate, and that he put in considerable effort in trying to find her. He may have been in the immediate territory at the time the female was killed. The

male returned to the den and ate the two kittens. Examination of the kittens showed that all edible portions were consumed, which included the entrails, and all of the skull and brains to a point well above the eye sockets. Not much of the hair of the kittens was eaten, but they gave the appearance of having been clawed down the bellies, and the entrails consumed.—S. P. YOUNG, *U. S. Biological Survey, Washington, D. C.*

THE LATEST NORTHERN ELEPHANT SEAL CENSUS

Through the courtesy of Dr. Harry M. Wegeforth, president of the Zoological Society of San Diego, the writer was recently invited to participate in a trip to Guadalupe Island, Mexico, organized for the purpose of capturing three northern elephant seals (*Mirounga angustirostris*) for the San Diego Zoo. Permits had been provided by the Mexican government, whose representatives accompanied the party. The 230-mile voyage from San Diego was made aboard Eagle Boat 34, which was placed at the disposal of the Zoological Society by the U. S. Navy. The personnel included a squad of marines under command of Capt. W. T. Clement and a detachment of naval reserves under Lieut. E. W. Dort.

Landing on the elephant seal beach in the first boat about 6:30 a.m. on June 23, 1926, I was immediately impressed and much pleased by the evident large number of the animals. Storms had changed the topography of the beach considerably since my last visit (August 30, 1924), much of the sand having been removed and replaced by cobbles. On the two remaining sandy areas the seals were resting in two compact masses, a fair-sized bunch on the northern end and by far the larger group on the southern end. Seeking a vantage point on the rocks above the beach, I made a careful count of the seals before they were disturbed. The result was 134 animals in the northern herd and 306 in the southern herd. Photographs that were made of the two herds were subsequently examined under a strong magnifying glass and confirmed the count. While we were rowing from the Eagle Boat to the beach, the sonorous bellow of elephant seals was heard from a cave to the north of the beach and a few were seen swimming in the surf near a rocky point about a quarter of a mile north. A conservative estimate of these animals would be 25, which, added to the 440 counted lying on the beach, makes a grand total of 465, the largest census yet recorded.

The list of counts now made by representatives of the San Diego Society of Natural History is as follows: July 12, 1922, 264 (Anthony, Journ. Mammalogy, vol. 5, p. 146); July 16, 1923, 366 (Huey, Journ. Mammalogy, vol. 5, p. 238); August 30, 1924; 124 (Huey, Journ. Mammalogy, vol. 6, p. 126); June 23, 1926, 465. The condition of the herd on this latest visit was found to be quite comparable to that of July 16, 1923. The older animals were in full moult, many of them with hanging shreds of hair and skin all over their faces. Some of the younger animals, which might have been females, were rather emaciated, a condition not previously noted. There were more large animals on the beach at this visit than at any previous time and by far the greatest number were of the large, yellow-skinned type with huge proboscis. This season there were but three animals that could be definitely designated as immature ("yearlings"). The darker or "half-grown" ones were very much in the minority.

In capturing the three specimens for the San Diego Zoo, almost the entire herd

was driven from the beach and at this time the writer found the dried and crushed remains of four small elephant seals about thirty inches in length. This is the first direct evidence secured during the four visits listed above that the seals give birth to their young on this beach at Guadalupe Island. However, Dr. C. H. Townsend records (Zoologica, vol. 1, pp. 159–173) that, on March 2, 1911, of some 125 elephant seals on the beach, about fifteen were adult females, of which six were accompanied by newly-born young. He adds that the indications were that the breeding season was just commencing and that other adult females might arrive later. The mystery of what becomes of the pups between March and June is still unsolved.

The proportion of the sexes on the beach at the time of the four summer visits between 1922 and 1926 is also not known. Anthony (loc. cit.) believed that all the seals counted by him in 1922 were males and that an equal number of females probably existed elsewhere. On the other hand, one female was examined on the beach in 1924, and, of the three animals captured this year (1926), two were small females and one a large male. There was no opportunity to investigate the sex of the other animals, as speed in getting the seals safely back to San Diego was naturally the paramount consideration. The first seals selected were corralled with portable fences, driven into crates and floated out to the Eagle Boat. By 3:00 p.m. all hands were aboard again, and by noon the following day the three seals were happily swimming in their pool at the zoo.

Only by visits in every month of the year, with opportunity for leisurely observation, can comprehensive facts be learned of the life-history of these interesting beasts. At least we can be encouraged by the definite evidence that the population of this heard of northern elephant seals, the only one known on earth, is not decreasing. In fact, thanks to the wise protection being afforded by the Mexican government, it appears to be increasing.—Laurence M. Huey, *Natural History Museum, Balboa Park, San Diego, California.*

SOUND PERCEPTION IN A HARVEST MOUSE

A lively individual of the long-tailed harvest mouse (*Reithrodontomys megalotis longicaudus*) was captured early in the spring (1926) on the hills back of Berkeley, California, and has been kept successfully in captivity for several weeks. It proves very sensitive to noises, re-acting conspicuously to squeaky sounds of any sort. Very loud squeaks, such as may be produced with the lips or by sucking on the back of one's hand, cause the mouse to run away and hide; but lesser squeaks, though seemingly unpleasant to it, cause merely a twitching of the ears at each repetition.

Tests with the Galton whistle indicate that this animal is able to hear sounds of about 35,000 vibrations (that is, half-vibrations) per second on hot, dry days and 23,000 vibrations per second on cold, rainy days. The humidity factor is probably the determining one in this case. My own limits of hearing under the above conditions were about 31,000 vibrations per second and 22,000 vibrations per second, respectively. I am told that the limit of human hearing is about 40,000 vibrations per second, all conditions being most favorable and the auditor a person of acute hearing. It seems, then, that this mouse is able to perceive sounds inaudible to the ordinary human ear.

The twitching of the ears would seem to be a sure sign that the animal is hearing a given sound. The figures given above indicate the number of vibrations per second at which, upon repeated trials, the ears ceased to move perceptibly. However, it is possible that this is merely the point at which the sound ceases to become acutely unpleasant, and that the mouse really perceives sounds of much higher pitch to which it does not re-act in such a way as to be noticeable to the observer.—ALONZO C. DAVIS, *Department of Zoology, University of California, Berkeley, California.*

A MUSICAL MOUSE

A recent newspaper item about "a musical mouse" reminds me of an experience of my own while I was a clerk in the office of the U. S. District Attorney in Vicksburg, Mississippi. It was in 1871 or 1872, I think. Anyhow, it was the year that yellow fever was epidemic in Vicksburg. The epidemic caused a general exodus of all who could get away, and most of my acquaintances had gone north to escape contagion. Vicksburg was then a pretty dull place, and I often returned to the office after supper and spent the evening in reading. Our office was in the second story of a brick building which was separated from another brick building by a party wall. In this wall, midway between the front and rear of our office, was an open fire-place with a grate and a brick hearth in front of the grate.

One evening, while reading, I heard a sound like the distant song of a bird. After listening a bit, I concluded that some bird was singing in the adjoining building. My conclusion seemed to be confirmed by the fact that when I placed my ear against the wall, the sound was more distinct. This explanation seemed so plausible that I gave the matter no further thought, though I heard the same sound several times in the next two or three evenings.

Then I observed that sometimes the sound was louder than at other times and that when I was near the fire-place I could hear it more distinctly than elsewhere. The singing now aroused my curiosity and afforded some amusement as well. I began to watch for it, and, if I did not hear it soon after I reached the office I would begin whistling. I do not know that my whistling had effect. I can only say that sometimes the singing would commence two or three minutes after I began my whistling.

One evening the singing was unusually loud and clear and seemed to come directly from the fire-place. While I was watching the fire-place the song ceased, and to my surprise a mouse crept out of a hole in the brick wall of the fire-place and ran out on the hearth in front of the grate. A moment later, to my much greater surprise, the mouse began to sing the same song that I had been listening to for several evenings. I never heard it in the daytime. At last the mystery was solved. My unknown songster was just a mouse, a plain ordinary mouse, with nothing in color, size or shape, to distinguish it from the common house mouse.

It is hard to describe the singing of the mouse, or find a comparison for it. It was not quite like anything else I have ever heard. In a general way it somewhat resembled the singing of a bird, though not so loud, and yet it was not like the song of any bird I knew.

After this first appearance of the mouse upon the hearth, I heard it singing

nearly every evening I spent in the office. Sometimes it was so far back in the wall that the sound was barely audible. Sometimes it sat singing in the mouth of its hole, and sometimes it came clear out on the hearth and sang. At first the mouse was very timid and the least movement of mine would cause it to dart back to its hole in the wall. Gradually, however, it became bolder, and finally seemed to have lost all fear of me.

Occasionally, I carried some crumbs from the supper-table to the office and dropped them on the hearth for the mouse. On the evening when I last heard the song, I had carried no crumbs, but just before leaving the office on that evening I ate an apple, without peeling it, and, chewing up the skin of the apple, I dropped bits on the hearth for the mouse. This seemed to suit its appetite. It did not seem at all afraid, and crept up to within two or three inches of my foot to pick up a bit that had fallen there. Apparently it ate more than it could digest, for the next morning, when I came to the office, the musical mouse lay dead on the hearth.—JOSIAH BURNHAM, *Lawrence, Kansas.*

MOOSE BECOMING A COMMON SIGHT IN YELLOWSTONE NATIONAL PARK

For years the Yellowstone moose have been scattering out all over the park and into every little spring bottom and tiny swamp that contains any moose food. At the same time these unhunted moose are becoming so tame that they bid fair to become as great an attraction, and as celebrated, as Yellowstone's bears. As it is now, probably as many visitors see as many wild moose as they do specimens of the far more numerous elk, or wapiti. Today (June 18, 1926) two fine bull moose were seen within one and a half miles of headquarters at Mammoth and directly beside a prominent saddle horse trail, traversed each season by hundreds of tourists out for the novel experience of a saddle ride, in a western saddle, on a real western horse. M. P. SKINNER, *Yellowstone National Park, Wyoming.*

NOTES ON DISEASES IN WILD GAME MAMMALS

Mountain sheep

During February, 1925, an investigation was made of a disease which was causing the death of large numbers of mountain sheep (*Ovis canadensis*), in Sun River Canyon, Montana. Symptoms of the sick animals were lack of vitality shown in their movements, coughing, heaving, bleeding slightly at the nose, and standing with hind legs apart and braced backwards. Five sick sheep were examined and the following conditions noted.

Two-year old ram: (From laboratory report of Montana Livestock Sanitary Board) "Was in good physical condition. No pathological condition was found in the liver, spleen, kidneys or intestines. Posterior end of right lung was found adherent to the diaphragm and wall of the thorax. Left lung was entirely disintegrated—just a pulpy mass that looked like ground liver or coagulated blood, with the exception of a small portion of the posterior end of the diaphragmatic lobe, in which an abscess was found." Conclusions of the laboratory were that the animal was suffering from a virulent form of pneumonia.

Old ewe: This animal was so sick it could hardly travel. Left lung was adherent to the wall of the thorax and almost completely wasted away. Considerable pus was present round the left lung. Right lung was marked with considerable white areas and showed but little healthy material. Heart, kidneys, liver and intestines normal. Very poor physical condition and undoubtedly would have lived but a few days. Heart and lungs were sent to the Montana Livestock Sanitary Board and their laboratory reported. "Our diagnosis of this trouble is pneumonia."

Lamb: Showed signs of sickness in movements. Lungs were of a color somewhat darker than the liver and of a consistency that would amost allow stirring with a stick. Lungs were simply rotten. A number of almost black ulcers were on the lungs. The animal would probably have lived a week or ten days longer. Kidneys, liver, and intestines appeared normal.

Four or five year old ram: In poor physical condition. Lungs had a white strip around the edge of the lobes, varying in width from one-fourth to two inches, also white spots of from one-half to one inch in diameter inside the white strip. Some congested area of considerable size and numerous dark ulcers on the lungs were noted. Before being killed, this animal was apparently normal, and showed considerable life in its movements.

Three or four year old ewe: Had been suckling a lamb but was in good physical condition. Lungs showed congested areas, numerous ulcers, considerable white areas and a wasted white strip around the lobes varying in width from one-fourth inch to 3 inches. Heart, kidneys, liver, and intestines normal. This animal was no doubt in the first stages of the disease.

Later in March, two lambs were killed for the U. S. Bureau of Animal Industry. These were in an extremely emaciated condition and seemed almost ready to lie down and die. The chief of the bureau reported that: "Lungs showed some congestion but no evidence of pneumonia or solidification. . . . . Tape worms were found in the small intestines and livers of both lambs. In one of the livers both bile ducts were plugged with these parasites. Large numbers of a small stomach worm (*Ostertagia marshalli*) were found in the fourth stomach. These parasites occurring in excessive numbers might readily have caused an emaciated and weakened condition, such as was observed in these two lambs at time of slaughter."

During the winter of 1924–25, disease reduced the Sun River sheep from about two hundred fifty head to about sixty-four. It was confined to a relatively small area and apparently did not affect the mountain sheep on other ranges nearby.

Prong-horn antelope

A two-year male antelope died in captivity at Livingston, Montana, on February 28, 1926. Examination showed it to be in very poor physical condition. Lungs were of almost black color and a mass of hard ulcers. Considerable pus was present about the lungs. Lymphatic glands were greatly enlarged and markedly diseased. Liver was covered with ulcers. Stomach, kidneys, and intestines normal. The Montana Liverstock Sanitary Board gave a diagnosis of miliary tuberculosis in this case.

Elk

Cow elk, examined March 4, 1926. Good physical condition. Had been wounded by gun shot, four to ten days previous, in right hip, part of the bullet lodging in the pelvic cavity. Was with calf. Lungs somewhat discolored, but no marked infection or congested areas. Spleen was covered with hard ulcers. Liver very spotted. Considerable pus present around lower large intestine. Badly constipated. Diseased lungs and spleen considered to be hemorrhagic septicemia, although no laboratory examination was made to definitely determine this.

Porcupine

Examined March, 1926. In good physical condition. Heart was apparently atrophied on the left side. There is a great scarcity of these animals in this region this year, although last year they were extremely numerous. It is possible that some disease affecting their hearts has greatly depleted their numbers.

Muskrat

Two muskrats were found with hearts in condition similar to that of the porcupine. One of these animals was also afflicted with a large number of worms in the intestines.

Beaver

Examined March, 20, 1926. Stomach contained numerous worms identified as *Travassosius americanus* by the U. S. Bureau of Animal Industry. Animal was barren female, in poor physical condition, due no doubt to the presence of these worms.—W. M. Rush, *U. S. Forest Service, Livingston, Montana.*

RECENT LITERATURE

Howell, A. Brazier. ANATOMY OF THE WOOD RAT. Monographs of the American Society of Mammalogists, no. 1. Baltimore: The Williams & Wilkins Company. 8vo, x + 225 pp., 3 plates, 37 figures. Cloth, $5.00. October, 1926.

To the working zoologist, be he teacher, investigator, or of that numerous band whose duty it is to answer the many questions propounded by a large and insistent lay public, no books are so constantly and so frequently useful as those which give detailed, well illustrated descriptions of the structure of common animals. And yet, how few such books there are! The guinea pig teems in every laboratory, but a useful account of its anatomy is still one of our desiderata. Practically, for common mammals of our own country, no such descriptions are available.

The work before us attempts to serve this very useful purpose. It undertakes the anatomical description of the genus *Neotoma*, which includes among others the common wood rat of the East, and that interesting rodent, the pack rat of the Far West. The account, to be sure, is not complete. Nothing is said of the organs of respiration and of circulation, and very little about the nervous system and the endocrine glands. The alimentary tract and the urogenital system are adequately described and illustrated. But chief stress is placed, and very rightly too, on the skeleton and the musculature. Complete and most painstaking descriptions are given of both. On every page there is evidence of the great care taken to make these descriptions as accurate as circumstances would allow. This excellence extends to the illustrations, which, without employing any elaborate or expensive processes of reproduction, serve their purpose in admirable manner. In the figures of the skeleton frequent use has been made of a very admirable scheme of indicating areas of muscle origin in blue, those of insertion in red. It is a device that deserves imitation in some of our text books of anatomy.

The book closes with an interesting and suggestive discussion of certain points concerning muscle action, and a comparison of such actions in the forms under consideration. The discussion of the limb muscles in relation to the modes of locomotion is particularly illuminating.

The officers of the Society of Mammalogists are to be commended highly for the courage and the wisdom they have exhibited in arranging for the publication of this book. May the series of Monographs which it inaugurates, soon become a long line of similarly useful volumes.—GEORGE WAGNER.

Schmoe, F. W. OUR GREATEST MOUNTAIN: A HANDBOOK FOR MOUNT RAINIER NATIONAL PARK. New York and London: G. P. Putnam's Sons. 8 vo, pp. xii + 366, 64 illus., 1 map. 1925.

Here is a well illustrated book, which in style, format, and illustrations is exceedingly attractive, and appears to have the mark of authority, but which, at least as far as the treatment of the mammals is concerned, is exceedingly inaccurate. The work is divided into four parts, called books, as follows: The Mountain; The National Park; Fauna and Flora; and Winter on the Mountain. We are interested primarily in the chapter on "Animals of the Park," and it becomes the unpleasant duty of the reviewer to point out a few of the inaccuracies

in this chapter, in order that others may use proper caution in accepting the statements.

Page 231: "Small as the Park is," says Schmoe, "compared with the region of similar nature surrounding it, practically every land form of wild animal life common to the Northwest is found within its borders. Fifty-four mammals have been listed." Yet there are about 160 forms of mammals in the state of Washington alone, not to mention "the Northwest!" An equally loose statement is "about one-fourth would be classed as big-game animals." Perhaps one-fourth would be such by the inclusion of the mountain lion, bobcat, wolf, coyote, skunk, and similar mammals as "big game."

Page 240: The bobcat is referred to as *Lynx uinta*, spelled *"vinta."* The form *uinta* is unknown in Washington, all bobcats from that state being referable to *fasciatus*.

Page 243: The hoary marmot of Mount Rainier is not *Marmota pruinosa*, as Schmoe has it, but *Marmota caligata cascadensis*.

Page 249: The least weasel, *Mustela rixosa*, does not occur in the region, but Streator's weasel, *Mustela cicognanii streatori*, does.

Page 250: The name *Spilogale putorius* is employed for the little spotted skunk. The right name is *Spilogale phenax olympica*. The species *putorius* is found only in southeastern United States.

Page 251: Mount Rainier National Park is the type locality of *Aplodontia rufa rainieri*, a form described by Merriam in 1899. In the present work this mammal is listed under the name *Aplodontia rufa phaea*, a subspecies occurring on the coast of Oregon.

Page 254: The Cascade golden-mantled ground squirrel, *Callospermophilus lateralis saturatus*, is by Schmoe called the "Columbia Mantled Ground Squirrel (*Citellus columbianus columbianus*)." The latter will be recognized as the name of the Columbian ground squirrel, an entirely different animal not known to occur in Washington west of the Columbia River.

Page 255: *Eutamias* (misprinted *Entamias*) *townsendii* is the name given by Schmoe to the little chipmunk of Mount Rainier. *Townsendii*, however, is a larger chipmunk of a different group, occurs principally in the lowlands of western Washington, and is represented by the subspecies *cooperi* on Mount Rainier. The correct name for the little chipmunk is *Eutamias amoenus caurinus*.

Page 260: The correct name of the deer mouse of Mount Rainier is *Peromyscus maniculatus oreas*, not *Peromyscus leucopus*. The latter is a species of the eastern and middle United States, and does not range within a thousand miles of Mount Rainier!

Page 261: The red-backed mouse of the park is *Evotomys gapperi saturatus*, not *occidentalis*, as listed, which is the form of the lowlands of western Washington.

Page 264: Under the heading "Moles, *Scapanus* sp." the Townsend mole, the coast mole, and the Gibbs shrew mole are listed. The latter, however, is not a *Scapanus*, but belongs to another genus, *Neürotrichus*.

A footnote to the chapter on "Animals of the Park" reads: "Much of the material . . . . is from notes by Dr. E. W. Nelson . . . . and Mr. William P. Taylor. It is here used by permission. . . . ." Quotations from the latter author are from Dr. Walter P. Taylor, not "William," and are taken from "Twelve

characteristic mammals of the park," Rules and Regulations of the Park, 1920. Many of the statements in the different accounts of the animals are taken verbatim or nearly verbatim from Taylor's paper above mentioned. The paper is not cited, nor are the verbatim statements included in quotation marks. A minimum observance of the proprieties governing the use of another's work should require quotation marks when such extracts are made.

It is indeed a pity that the mammal part of this book is so superficial, as there is great need for reliable books on the wild life of our national parks. Even as it is it will probably promote interest in the natural history of the park. A little more care would have made the work an admirable semi-popular text-book on one of the most interesting regions of America.—HARTLEY H. T. JACKSON.

Yerkes, Robert M. THE MIND OF A GORILLA. Genetic Psychology Monographs, vol. 2, nos. 1 and 2, Clark University, Worcester, Massachusetts. 193 pp., 9 pls. Paper, $3.00. December, 1926.

Comment on the part of any reviewer upon a contribution by this able investigator of anthropoid behavior is mere presumption. The present book is characteristic of the author; it is scientifically accurate, yet interesting and readable. Congo, a five-year-old mountain gorilla (*Gorilla beringei*) brought from Africa by Ben Burbridge and in his possession at Jacksonville, Florida, was the subject of Doctor Yerkes's experimental studies for six weeks during January and February, 1926. After giving us an outline of the history of Congo and a review of our knowledge of the mentality of the gorilla, Yerkes describes a series of experiments upon his subject, discusses results, makes comparisons, and draws conclusions. Congo displayed slower mentality but greater patience and judgment than the chimpanzee. She proved friendly, coöperative, docile, and showed little activity, curiosity, and imitativeness. She appeared to be calm, even-tempered, and self-dependent.

"By means of sticks, ropes, chains, bottles, boxes, a mirror, and other simple appliances, more than a score of novel problems were set for Congo. Most of them she solved eventually, some by what appeared like random action and the selection of profitable acts, others by observation of essential features or relations in the situation and immediate adaptation. Evidences of psycho-physiological processes in the gorilla are abundant and varied. Clearly 'trial and error' as a description of adaptive procedure is incomplete and frequently inapplicable. Often there appear evidences of 'critical points' in adaptive endeavor at which the nature of activity suddenly changes. Many of the objective characteristics in these suddenly achieved adaptations are observed in human ideational behavior. It therefore seems probable that the animal experiences insight. Various experiments prove that 'out of sight' is not necessarily 'out of mind.'"—HARTLEY H. T. JACKSON.

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CORRESPONDENCE

CARL AKELEY'S LAST WORDS ABOUT AFRICA

Editor, Journal of Mammalogy:

If there is any reader of the JOURNAL OF MAMMALOGY who still thinks that the game of East Africa is being properly protected from extermination, let him read Carl Akeley's words, written in September, 1926, a few weeks before his tragic death in Africa, and published in an editorial in the New York Times, December 2, 1926.

"I have just come in from a two day's trip down the Tana, through a region I have known only as swarming with game, but I now find it a complete waste. There is only a pitiful remnant of the great buffalo herds of the past, and of the other game almost nothing. This is a condition we have found everywhere we have been in Kenya Colony. I have not appreciated the absolute necessity of carrying on the African Hall, if it is ever to be done, as I now do after this painful revelation."

Let us be honest with ourselves. If the game of East Africa is to be allowed to be blotted out, let us frankly admit that it is not through our ignorance of conditions, but because of the sheer indifference of mammalogists and sportsmen, both in our own country and, to a lesser extent, elsewhere.

HENRY R. CAREY.

Philadelphia, Pa.,
January 26, 1927.

THE TERM "CRIME" APPLIED TO ANIMALS

Editor, Journal of Mammalogy:

In the November, 1926, Journal of Mammalogy, page 284, it states "sometimes returning to the scene of its crime long after the meat fails to appeal to him." This refers to the mountain lion.

It seems very strange to me that a naturalist should consider it a "crime" for an animal to kill another animal for its food. If such is the case, then we are emphatically condemning a vast number of hunters who do not kill for the primary purpose of getting food, but for pure love of killing something. This class of hunters could obtain a greater amount of food for the money it costs them to hunt, than the value of the meat they obtain by hunting. Deer hunters, for example, will spend from one to five hundred dollars to obtain one deer, the food value of which may be less than twenty dollars.

Either we must omit such terms as "crime," "sly," "cruel," "sneaky," "fierce," etc., in describing the habits of animals in obtaining their food, or thereby condemn a large body of sportsmen-hunters and trappers. Such people outdo the brute world in all of the qualities indicated by such words as used above and, with the exception of trappers, do it for sport and not as a need of preserving themselves from death by starvation.

I do not object to hunting within reason, but I do object to condemning animals for using their natural means of obtaining food in terms which we do not apply to hunters when killing for the fun of it.

JULIUS M. JOHNSON.

Haaren High School,
Manhattan, New York.
February 24, 1927.

COMMENT AND NEWS

During the past few weeks several changes have been made in the administrative personnel of the Biological Survey. Effective January 1, Walter C. Henderson, for ten years assistant chief of the Survey and previous to that in the Forest Service and the Solicitor's Office of the U. S. Department of Agriculture, was promoted to the title of associate chief, a position created on that date. On May 9, Dr. E. W. Nelson, having requested the Secretary of Agriculture to relieve him of executive responsibility in order that he might devote his time to research, retired as chief of the Survey, but continues with the bureau as senior biologist. Doctor Nelson has been associated with the Survey since 1890, and has been chief since 1916. Paul G. Redington succeeded Doctor Nelson as chief on May 9. Mr. Redington was assigned to the Survey as associate chief on February 16 to allow him to become familiar with the work of the bureau. He is a graduate of Dartmouth College and the foresty school of Yale University, has been with the Forest Service almost continuously since 1904, and previous to his assignment to the Survey had been for several months assistant chief, in charge of public relations, in the Forest Service. Effective March 1, Dr. W. B. Bell was placed in charge of the

division of biological investigations, having been transferred from the division of economic mammalogy, where he was frequently acting in charge. Doctor Bell has been with the Biological Survey over ten years, going there from the North Dakota Agriculture Experiment Station. Stanley P. Young, a Biological Survey field project-leader, will fill the vacancy in economic mammalogy in the Washington office. Dr. Hartley H. T. Jackson, who was acting in charge of the division of biological investigations for nearly two years, is again in charge of the mammal collection, and will continue research. Doctor Jackson has been with the Survey since February, 1910, having been called from the University of Wisconsin, where he was assistant in zoology. Arthur H. Howell, with the Survey for over thirty years and who recently has been in charge of the mammal collection, is to spend his entire time on research.

The Zoological Society of San Diego, California, has just completed a zoological hospital and research institute, especially designed and fully equipped for biological research. The building is to serve as a hospital for the animals in the local zoo, to serve as a place where animal diseases can be systematically studied, and to afford to students of biology a laboratory, where they can pursue their studies with unusual opportunities. It provides accommodation for thirty research workers. Laboratory and equipment will be supplied without charge, and investigators may follow any type of work in which they are interested. The building was sponsored by a group of progressive physicians. It is ideally located, and the only one of its kind in the western United States. No doubt in time it will develop into an important center for scientific investigations.

Dr. W. D. Matthew, retiring president of the society, has resigned from his position as curator-in-chief of the division of mineralogy, geology, geography, and astronomy at the American Museum of Natural History to accept that of professor of palaeontology at the University of California. Doctor Matthew will take up his new duties on July 1.

The annual report for Yellowstone National Park for the fiscal year 1926 showed the following counts of wild animals:

Buffalo—Lamar River herd	846	
Buffalo—Cold Creek-Pelican Creek herd—actual count 65, estimated total	125	
Total		971
Mountain sheep—actual count 217, estimated total		600
Antelope—actual count 546, estimated total		600
Moose—actual count 103, estimated total		575
Deer, mule—actual count 798, estimated total		1,850
Elk—estimated total based on counts procured in May, 1923, and April, 1925 (This figure includes the Yellowstone, Gallatin and Madison herds and is exclusive of the bands that winter in the Jackson Hole)		20,000
Bear—black and brown—actual count 73, estimated total		225
Bear—grizzly—actual count 37, estimated total		80

A count of the elk in the Jackson Hole, Wyoming, herd has just been completed by members of the U. S. Biological Survey and the Forest Service, and the State Game Commission of Wyoming, accompanied by representatives of the Izaak Walton League of America. Reports show that the herd now numbers 19,238, a total that is only slightly different from the results of a similar count two years ago. At the time of the count nearly half the elk were on the feeding grounds of the winter refuge maintained by the Biological Survey. That the herds are still within the optimum number of 20,000, set by the recent Elk Commission created by the Conference on Outdoor Recreation, came as a surprise to government officials. They state that in a disastrous winter six years ago thousands of elk died from starvation, leaving a remnant of only 9,346. A doubling of the numbers between 1921 and 1925, when the count showed 19,483, suggested that a continued increase might be expected, especially as recent winters had been favorable to the elk and comparatively few had been killed by hunters. Unexpected results like these emphasized the necessity of an intensive investigation of all conditions affecting the elk of the whole Yellowstone region. Following the recommendations made by the Elk Commission, the Biological Survey is formulating plans for beginning the work.

The southern Yellowstone elk in winter migrate for the most part southward to the vicinity of Jackson, Wyoming. Several hundred, however, have recently been reported west of the Tetons in Idaho, and there is some intermingling eastward in Wyoming with herds along the Wind and Green rivers, which may account for the apparent lack of increase in the numbers about Jackson. However, an insufficient crop of hay produced on the elk refuge, even if supplemented by the purchase of hay by the state game commissions in an unusually severe winter, could easily bring about a repetition of former disasters, when an over-concentration of elk on limited areas exhausted the forage that would have supported normal numbers. Conservationists are working to prevent the starvation of elk. Present plans call for maintaining the Wyoming herd in numbers not to exceed 20,000 and preventing an accumulation of what could easily become an unwieldly surplus, threatening through starvation the existence of the herd. The present count shows that the Wyoming elk have for two years been close to the danger line in abundance.

Joseph Mailliard resigned from the curatorship of ornithology and mammalogy at the California Academy of Sciences effective February 28, and has been appointed curator emeritus. The position of curator has been filled by the appointment of Harry S. Swarth, formerly of the Museum of Vertebrate Zoology, University of California.

The ground floor of the Zoological Museum of the Academy of Sciences, Leningrad, Russia, where the osteological collections had been stored, was flooded to a depth of several feet during the flood of 1924. Fortunately, the collection of mammal skulls was not seriously damaged, and the labels and marks withstood the severe test. However, cabinets were overturned and the contents mixed, and it has taken several months to move the collection to new rooms and put it in order. The collection of skins, which was kept on another floor, was not damaged.

The skins of the famous lions described by Col. J. H. Patterson in his well known book "The Man Eaters of Tsavo," have been presented to the Field Museum of Chicago, where they have been mounted and placed on exhibition.

Revised regulations relating to mammals in Alaska become effective July 1. The following changes are of interest:

The caribou season in that part of fur district No. 2 north of the summit of the Alaska Range and Ahklum Mountains opens on August 1 instead of September 1, ending December 31 as heretofore.

The period September 1 to June 20 is the open season on black bear in district No. 2, but in that portion south of the Alaska Range and Ahklun Mountains a bag limit of two during the month of September is prescribed. The open season was formerly October 1 to May 31 in that area.

The opening and closing dates of seasons on certain fur bearers in designated areas were changed. The most important of these is the provision opening an area in east central Alaska to beaver trapping during the month of April, with a seasonal bag limit of ten beavers to each trapper. Nine small areas adjacent to the Alaska Railroad are designated in which the taking of fur-bearing animals and game is prohibited. These areas are set aside as preserves and breeding grounds especially for beavers and muskrats.

The new regulations (Alaska Game Commission Circular No. 3) may be obtained free from the U. S. Department of Agriculture, Washington, D. C.